The Geological Society of America Bulletin
Subject Index to Volume 88, No. 1-12, 1977

Absolute age
Dates
Igneous rocks, alkalic, volcanic, basaltic, whole rock, minerals, K/Ar, plate tectonics, continental drift, Jurassic, Cretaceous, Tertiary, Brazil, Atlantic Ocean, South Atlantic
(Herz, N.) 1 101
Igneous rocks, basalt, K/Ar, weathering, deep-sea environment, effects, Cenozoic, Pacific Ocean, Atlantic Ocean
(Seidemann, D. E.) 11 1660
Igneous rocks, basalt, lava, whole rock, K/Ar, data, factors, metamorphism, zeolite facies, paleomagnetism, time scales, boundary, Miocene, Pliocene, Iceland
(McDougall, I., *et al.*) 1 1
Igneous rocks, complexes, whole rock, K/Ar, Tertiary, Paleogene, India, Girnar
(Paul, D. K., *et al.*) 2 227
Igneous rocks, extrusive rocks, intrusive rocks, minerals, zircon, U/Pb, igneous activity, intrusions, Tertiary, Oligocene, Miocene, Washington, Tatoosh Intrusion
(Mattinson, J. M.) 10 1509
Igneous rocks, granite, whole rock, Sr/Rb, intrusions, plutons, metamorphism, Precambrian, Oligocene, Miocene, Utah, northwest
(Compton, R. R., *et al.*) 9 1237
Igneous rocks, granitic, quartz monzonite, quartz diorite, metamorphic rocks, gneiss, whole rock, Sr/Rb, data, isochrons, metamorphism, regional, metasomatism, basement, complexes, Precambrian, Wyoming, Bighorn Mountains
(Stueber, A. M., *et al.*) 3 441
Igneous rocks, granitic, Sr/Rb, K/Ar, data, isochrons, maps, isotopes, strontium, ratios, Mesozoic, Oregon, Washington, Idaho
(Armstrong, R. L., *et al.*) 3 397
Igneous rocks, granitic, volcanic, K/Ar, data, Cretaceous, Tertiary, Mexico, Sonora, coastal
(Gastil, R. G., *et al.*) 2 189
Igneous rocks, plutonic rocks, minerals, biotite, K/Ar, Sr/Rb, Tertiary, Texas, New Mexico, Trans-Pecos magmatic province, Diablo Platform
(Barker, D. S., *et al.*) 10 1437
Igneous rocks, plutonic rocks, whole rock, Sr/Rb, isochrons, time scales, orogeny, Acadian Orogeny, Devonian, New Hampshire Plutonic Series, New Hampshire
(Lyons, J. B., *et al.*) 12 1808
Igneous rocks, tholeiite, lava flows, whole rock, K/Ar, Quaternary, Hawaii, Lanai
(Bonhommet, N., *et al.*) 9 1282
Igneous rocks, volcanic rocks, calc-alkalic composition, K/Ar, volcanism, plate tectonics, Oligocene, Miocene, Mexico, Sierra Madre Occidental
(McDowell, F. W., *et al.*) 10 1479
Igneous rocks, volcanic rocks, phonolite, analcimite, whole rock, minerals, biotite, K/Ar, Cretaceous, Mississippi, west-central
(Sundeen, D. A., *et al.*) 8 1144
Metamorphic rocks, gneiss, granulite facies, whole rock, minerals, mica, K-feldspar, Sr/Rb, K/Ar, data, isochrons, overprinting, tectonics, plate tectonics, Precambrian, Paleozoic, Peru, Andes, Western Cordillera
(Cobbing, E. J., *et al.*) 2 241
Metamorphic rocks, gneiss, igneous rocks, granitic, whole rock, minerals, Sr/Rb, isochrons, isotopes, strontium, intrusions, batholiths, dikes, mafic, evolution, Precambrian, Wyoming, Sierra Madre
(Divis, A. F.) 1 96
Metamorphic rocks, metasedimentary rocks, gneiss, Sr/Rb, isochrons, metamorphism, shields, evolution, crust, accretion, Precambrian, Grenville Province, Quebec
(Doig, R.) 12 1843
Minerals, zircon, U/Pb, interpretation, discordance, lead, inherited, Paleozoic, Ordovician, Appalachians, Piedmont
(Higgins, M. W., *et al.*) 1 125
Sedimentary rocks, beachrock, C-14, changes of level, reefs, Holocene, Hawaii, Hanauma Reef
(Stearns, H. T., *et al.*) 10 1535
Sedimentary rocks, coal, volcanic ash, partings, minerals, plagioclase, K/Ar, Miocene, Alaska, Kenai Peninsula
(Triplehorn, D. M., *et al.*) 8 1156
Sediments, alluvium, charcoal, C-14, archaeological sites, Quaternary, New Mexico, Chaco Canyon
(Hall, S. A.) 11 1593
Sediments, minerals, glauconite, Sr/Rb, data, Paleocene, North Carolina
(Harris, W. B., *et al.*) 6 869
Sediments, peat, C-14, paleoclimatology, palynomorphs, Pleistocene, Atlantic Coastal Plain, Delmarva Peninsula
(Sirkin, L. A., *et al.*) 1 139
Soils, tephra, C-14, data, volcanism, Holocene, California, east, Mono Craters, Inyo Craters
(Wood, S. H.) 1 89

Afars and Issas Territory
Tectonophysics
Plate tectonics, geometry, Afar
(Barberi, F., *et al.*) 9 1251

Alabama
Structural geology
Tectonics, Valley and Ridge Province, Shelby County, Harpersville, Kelley Mountain
(Thomas, W. A., *et al.*) 9 1368

Alaska
Geochemistry
Metals, surface water, Yukon River
(Gibbs, R. J.) 6 829
Geochronology
Absolute age, fission-track, Miocene, south, Kenai Peninsula
(Triplehorn, D. M., *et al.*) 8 1156
Petrology
Volcanology, volcanism, Cenozoic, Aleutian Islands
(Price, C., *et al.*) 3 462
Structural geology
Faults, tectonics, south, Alaska Range, Denali Fault, Hines Creek Fault
(Hickman, R. G., *et al.*) 9 1217
Tectonics, structure, Bering Sea, Bering Strait
(Patton, W. W., Jr., *et al.*) 9 1298

Alberta
Sedimentary petrology
Sediments, drift, Quaternary, Athabasca Glacier
(Mills, H. H.) 8 1135

Appalachians
Geochronology
Absolute age, Paleozoic, Piedmont, Maryland, Virginia
(Higgins, M. W., *et al.*) 1 125
Stratigraphy
Devonian, Maryland, West Virginia, Allegheny Front
(McGhee, G. R., Jr.) 6 806
Structural geology
Deformation, field studies, structural analysis, Blue Ridge, Virginia, Rockbridge County, Warren County, Clarke County
(Wickham, J., *et al.*) 7 920
Folds, tectonics, Blue Ridge Province, Toxaway Dome, South Carolina, Oconee County, North Carolina, Transylvania County,

Jackson County
(Hatcher, R. D., Jr.) 11 1678
Tectonics, structure, folds, orientation, Valley and Ridge Province, Alabama
(Roeder, D., *et al.*) 1 157

Arctic Ocean
Geophysical surveys
Acoustical surveys, Barents Sea
(Houtz, R., *et al.*) 7 1030
Surveys, Barents Sea
(Eldholm, O., *et al.*) 7 1015
Tectonophysics
Sea-floor spreading, plate tectonics, ocean basins, Greenland Sea
(Talwani, M., *et al.*) 7 969

Arizona
Sedimentary petrology
Sedimentary structures, environmental analysis, sedimentary rocks, sandstone, Cambrian, Tapeats Sandstone, central
(Hereford, R.) 2 199
Structural geology
Tectonics, southeast, Cochise County, Pima County, Rincon Mountains
(Thorman, C. H., *et al.*) 8 1211
Tectonics, vertical tectonics, faults, northwest, Grand Canyon, Toroweap Fault, Hurricane Fault
(Huntoon, P. W.) 11 1619

Arkansas
Sedimentary petrology
Sedimentary rocks, tuff, sedimentation, Mississippian, Ouachita Mountains
(Niem, A. R.) 1 49

Atlantic Coastal Plain
Stratigraphy
Pleistocene, paleoclimatology, paleoecology, palynomorphs, Delaware, Maryland, Delmarva Peninsula
(Sirkin, L. A., *et al.*) 1 139

Atlantic Ocean
Geochemistry
Sulfur, igneous rocks, basalt, North Atlantic, Mid-Atlantic Ridge, FAMOUS
(Czamanske, G. K., *et al.*) 4 587
Trace elements, isotopes, strontium, North Atlantic, Mid-Atlantic Ridge, FAMOUS
(White, W. M., *et al.*) 4 571
Geochronology
Absolute age, Cenozoic, North Atlantic, Mid-Atlantic Ridge, Deep Sea Drilling Project, Leg 2
(Seidemann, D. E.) 11 1660
Time scales, paleomagnetism, absolute age, Miocene, Pliocene, Iceland, Borgarfjoerdur
(McDougall, I., *et al.*) 1 1
Geophysical surveys
Acoustical surveys, North Atlantic, Norwegian Sea
(Houtz, R., *et al.*) 7 1030
Heat flow, North Atlantic, Mid-Atlantic Ridge, FAMOUS
(Williams, D. L., *et al.*) 4 531
Seismic surveys, North Atlantic, Mid-Atlantic Ridge, FAMOUS
(Francis, T. J. G., *et al.*) 5 664
Seismic surveys, South Atlantic, Brazil, North Brazilian Ridge, Ceara Rise, Amazon Cone
(Houtz, R. E., *et al.*) 5 711
Oceanography
Instruments, ocean floors, North Atlantic, Mid-Atlantic Ridge, FAMOUS
(Ballard, R. D., *et al.*) 4 495
Ocean floors, North Atlantic, Mid-Atlantic Ridge, FAMOUS
(Ballard, R. D., *et al.*) 4 507
Ocean floors, North Atlantic, Mid-Atlantic Ridge, FAMOUS
(Heirtzler, J. R., *et al.*) 4 481
Ocean floors, North Atlantic, Mid-Atlantic Ridge, FAMOUS
(Luyendyk, B. P., *et al.*) 5 648
Ocean floors, North Atlantic, Mid-Atlantic Ridge, FAMOUS
(Macdonald, K. C., *et al.*) 5 621
Ocean floors, plate tectonics, North Atlantic, Mid-Atlantic Ridge, FAMOUS
(Ramberg, I. B., *et al.*) 4 577
Ocean floors, west, equatorial, Ceara Rise
(Kumar, N., *et al.*) 5 683
Sea water, North Atlantic, Mid-Atlantic Ridge, FAMOUS
(Fehn, U., *et al.*) 4 488
Sedimentation, continental shelf, North Atlantic, North Carolina, Diamond Shoals
(Hunt, R. E., *et al.*) 2 299
Sedimentation, transport, clay mineralogy, continental shelf, North Atlantic, Canada
(Piper, D. J. W., *et al.*) 2 267
Sedimentation, west, equatorial
(Damuth, J. E.) 5 695
Sediments, sedimentation, continental shelf, North Atlantic, Canada, Newfoundland, Grand Banks
(Slatt, R. M.) 9 1357
Sediments, South Atlantic, South America
(Houtz, R. E.) 5 720
Petrology
Igneous rocks, basalt, lava, North Atlantic, Mid-Atlantic Ridge, FAMOUS
(Bryan, W. B., *et al.*) 4 556
Igneous rocks, properties, crust, North Atlantic, Mid-Atlantic Ridge, FAMOUS
(Schreiber, E., *et al.*) 4 600
Sedimentary petrology
Sedimentation, transport, Quaternary, North Atlantic
(Ruddiman, W. F.) 12 1813
Tectonophysics
Paleomagnetism, igneous rocks, basalt, sea-floor spreading, North Atlantic, Mid-Atlantic Ridge, FAMOUS
(Johnson, H. P., *et al.*) 5 637
Plate tectonics, geometry, sea-floor spreading, North Atlantic, Mid-Atlantic Ridge, FAMOUS
(Ramberg, I. B., *et al.*) 5 609
Plate tectonics, processes, sea-floor spreading, geophysical surveys, North Atlantic, Mid-Atlantic Ridge, FAMOUS
(Macdonald, K. C.) 4 541
Plate tectonics, rifting, West Indies, Bahamas, Blake Plateau
(Mullins, H. T., *et al.*) 10 1447
Sea-floor spreading, plate tectonics, ocean basins, North Atlantic, Norwegian Sea
(Talwani, M., *et al.*) 7 969

Atlantic region
Paleontology
Invertebrata, Phanerozoic, Atlantic Ocean, North Atlantic, North America, Europe, Africa, North Africa
(Fallaw, W. C.) 1 62
Tectonophysics
Plate tectonics, geometry, Atlantic Ocean, North Atlantic, North America
(Kristoffersen, Y., *et al.*) 7 1037

Automatic data processing
Seismology
Earthquakes, algorithms, patterns, characterization, discrimination, prediction, California, Nevada
(Briggs, P., *et al.*) 2 161
Structural geology
Deformation, strain, orientation, paths, models, computers, Cambrian, Conococheague Formation, Appalachians, Blue Ridge, Virginia
(Wickham, J., *et al.*) 7 920

Biogeography
Invertebrata
Phanerozoic, Atlantic region, North America, Europe, North Africa, concepts, genera, commonality, continental drift, orogeny, plate tectonics
(Fallaw, W. C.) 1 62
Biography
General
Boulton, Geoffrey Stewart, awards, Kirk Bryan Award
(Lattman, L. H., *et al.*) 7 1053
Cloud, Preston E., Jr., medals, Penrose Medal
(McLaren, D. J., *et al.*) 7 1050
Neuman, Shlomo P., awards, Oscar E. Meinzer Award
(Davis, S. N., *et al.*) 7 1054
Ramberg, Hans, medals, Arthur L. Day Medal
(Reitan, P. H., *et al.*) 7 1051
Varnes, David J., awards, E. B. Burwell, Jr., Award
(Wilson, F. W., *et al.*) 7 1055
Witherspoon, Paul A., awards, Oscar E. Meinzer Award
(Davis, S. N., *et al.*) 7 1054
Brachiopoda
Articulata
Devonian, Appalachians, Allegheny Front, range, biostratigraphy, Atrypidae, *Athyris angelica, Cyrtospirifer sulcifer*
(McGhee, G. R., Jr.) 6 806
Brazil
Geochemistry
Metals, surface water, Amazon River
(Gibbs, R. J.) 6 829
Geochronology
Absolute age, Jurassic, Cretaceous, Tertiary, south
(Herz, N.) 1 101
Petrology
Inclusions, xenoliths, igneous rocks, volcanic, Tertiary, northeast, Paraiba, Rio Grande do Norte
(Sial, A. N.) 8 1173
California
Geochronology
Tephrochronology, absolute age, Holocene, east, Sierra Nevada, Mono County, Mono Lake, Mono Craters, Long Valley, Inyo Craters
(Wood, S. H.) 1 89
Geomorphology
Processes, erosion, weathering, southeast, Inyo County, Death Valley
(Hooke, R. L., *et al.*) 8 1177
Shore features, south, San Diego County, San Diego
(Kern, J. P.) 11 1553
Petrology
Igneous rocks, ophiolite, metamorphic rocks, Paleozoic, Triassic, north, Siskiyou County, Klamath Mountains, Preston Peak
(Snoke, A. W.) 11 1641
Metamorphic rocks, metasedimentary, Mesozoic, Franciscan Belt, Diablo Range
(Bloxam, T. W., *et al.*) 3 480
Seismology
Earthquakes, regional
(Briggs, P., *et al.*) 2 161
Interior, south, San Bernardino County, Los Angeles County, Ventura County, Transverse Ranges
(Hadley, D., *et al.*) 10 1469
Stratigraphy
Holocene, modern, paleoclimatology, sedimentation, Santa Barbara Basin
(Soutar, A., *et al.*) 8 1161
Paleozoic, lithostratigraphy, Sierra Nevada, Plumas County, Sierra County
(Durrell, C., *et al.*) 6 844
Silurian, Devonian, biostratigraphy, Great Basin
(Johnson, J. G., *et al.*) 10 1462
Structural geology
Deformation, field studies, east, Sierra Nevada, Mono County, Madera County, Devil's Postpile Quadrangle, Ritter Range, Mount Ritter
(Tobisch, O. T., *et al.*) 1 23
Faults, displacements, south, San Bernardino County, Mojave Desert, Galway Lake
(Hill, R. L., *et al.*) 10 1378
Folds, distribution, structural analysis, Sierra Nevada, Mono County, Saddlebag Lake
(Brook, C. A.) 3 321
Structural analysis, interpretation, central, Sierra Nevada, Madera County, Oakhurst
(Russell, L. R., *et al.*) 10 1530
Structural analysis, interpretation, Sierra Nevada, Mono County, Mount Morrison
(Russell, S., *et al.*) 3 335
Tectonics, south, San Bernardino County, Mojave Desert, Old Dad Mountain
(Dunne, G. C.) 6 737
Tectonics, structure, intrusions, batholiths, east-central, Sierra Nevada
(Oliver, H. W.) 3 445
Cambrian
United States
Appalachians, Virginia, sedimentary rocks, deformation, structural analysis, Conococheague Formation
(Wickham, J., *et al.*) 7 920
Arizona, paleoenvironment, sedimentation, sedimentary structures, Tapeats Sandstone
(Hereford, R.) 2 199
Carbon
Abundance
Sediments, sand, organic carbon, Invertebrata, ecology, continental shelf, Georgia
(Pinet, P. R., *et al.*) 12 1731
Cenozoic
Africa
Ethiopia, Afars and Issas Territory, Afar, volcanism, plate tectonics
(Barberi, F., *et al.*) 9 1251
Geochronology
Absolute age, basalt, deep-sea environment, weathering
(Seidemann, D. E.) 11 1660
Indian Ocean
Agulhas Plateau, sedimentation, unconformities
(Tucholke, B. E., *et al.*) 9 1337
Melanesia
Solomon Islands, plate tectonics, volcanism, sedimentation
(Hughes, G. W., *et al.*) 3 412
Northern Hemisphere
Regional, paleoclimatology, paleogeography, continental drift, polar wandering
(Donn, W. L., *et al.*) 3 390
Pacific Ocean
North Pacific, sedimentation, plate tectonics
(Scholl, D. W., *et al.*) 11 1567
United States
Alaska, Aleutian Islands, volcanism, magmas, plate tectonics, upper Cenozoic
(Price, C., *et al.*) 3 462
Utah, southwest, volcanism, plate tectonics, Tertiary, Quaternary
(Hausel, W. D., *et al.*) 12 1831
Central America
Seismology
Seismicity, earthquakes, regional
(Carr, M. J., *et al.*) 1 151
Chad
Geomorphology
Volcanic features, Tibesti Massif
(Malin, M. C.) 7 908

Clay mineralogy
Areal studies
Canada, Maritime Provinces, continental margin, sediments, cores, deep sea
(Piper, D. J. W., *et al.*) 2 267
Coelenterata
Anthozoa
Silurian, Devonian, Nevada, California, Great Basin, biostratigraphy, zoning, corals, assemblages
(Johnson, J. G., *et al.*) 10 1462
Colombia
Geochemistry
Major elements, trace elements, volcanic rocks, tholeiite, Cretaceous, Eocene
(Goossens, P. J., *et al.*) 12 1711
Colorado
Mineralogy
Silicates, central, Teller County, Chaffee County, Brown's Canyon, Trout Creek, Victor
(Harris, R. L., Jr.) 12 1828
Petrology
Igneous rocks, quartz monzonite, intrusions, stocks, Precambrian, central, Mosquito Range, Park County, Lake County, Leadville, Treasurevault Stock
(Kuntz, M. A., *et al.*) 3 465
Stratigraphy
Precambrian, Paleozoic, paleomagnetism, Fremont County, Custer County, Wet Mountains, Iron Mountain, McClure Mountain
(French, R. B., *et al.*) 12 1785
Connecticut
Geomorphology
Glacial geology, glaciation, Pleistocene, New London County, Windham County, Tolland County, Shetucket River basin
(Black, R. F.) 9 1331
Geophysical surveys
Radioactivity methods, New London County, Windham County
(Goldsmith, R., *et al.*) 7 925
Continental drift
Atlantic region
North America, Europe, North Africa, paleontology, Invertebrata, biogeography, genera, commonality, concepts, Phanerozoic
(Fallaw, W. C.) 1 62
South America, Brazil, absolute age, igneous rocks, alkalic, Jurassic, Cretaceous, Tertiary
(Herz, N.) 1 101
Europe
Mediterranean region, Sardinia, Corsica, Alps, reconstruction, Oligocene
(Chabrier, G., *et al.*) 11 1694
Gondwana
Australasia, New Zealand, Antarctica, Australia, reconstruction, models, geosynclines, interpretation, Mesozoic
(Griffiths, J. R., *et al.*) 8 1203
Continental shelf
Canada
Maritime Provinces, sedimentation, clay mineralogy, Quaternary
(Piper, D. J. W., *et al.*) 2 267
Newfoundland, Grand Banks, sediments, lithofacies, sedimentation, Quaternary
(Slatt, R. M.) 9 1357
United States
Atlantic Coastal Plain, inner shelf, barrier islands, genesis
(Otvos, E. G., Jr., *et al.*) 5 734
North Carolina, Diamond Shoals, sedimentation, transport, patterns, bottom features, ridges, troughs, sand waves, bathymetry, sonar, side-scanning
(Hunt, R. E., *et al.*) 2 299
Continental slope
South America
Brazil, structure, seismic surveys
(Houtz, R. E., *et al.*) 5 711
Cretaceous
Europe
Italy, Gubbio, biostratigraphy, zoning, foraminifera, geochronology, paleomagnetism, upper Cretaceous
(Premoli Silva, I.) 3 371
Italy, Gubbio, geochronology, paleomagnetism, upper Cretaceous
(Roggenthen, W. M., *et al.*) 3 378
Italy, Gubbio, geochronology, paleomagnetism, upper Cretaceous, Scaglia rossa
(Lowrie, W., *et al.*) 3 374
Italy, Gubbio, geochronology, time scales, paleomagnetism, type section, upper Cretaceous
(Alvarez, W., *et al.*) 3 383
Italy, Gubbio, sedimentary rocks, lithostratigraphy, thickness, boundary, geochronology, paleomagnetism, upper Cretaceous, Scisti a fucoidi, Scaglia bianca, Scaglia rossa
(Arthur, M. A., *et al.*) 3 367
Melanesia
Solomon Islands, Malaita, volcanism, sedimentation, upper Cretaceous
(Hughes, G. W., *et al.*) 3 412
Mexico
Coahuila, limestone, lithostratigraphy, biostratigraphy, foraminifera, Protista, Tintinnidae, lower Cretaceous, Aurora Limestone
(Lozej, G. P., *et al.*) 12 1793
South America
Brazil, absolute age, igneous rocks, alkalic, plate tectonics, continental drift
(Herz, N.) 1 101
United States
Mississippi, west-central, igneous rocks, volcanic rocks, absolute age, upper Cretaceous
(Sundeen, D. A., *et al.*) 8 1144
Utah, sedimentation, paleoenvironment, transgression, unconformities, disconformities, upper Cretaceous, Frontier Formation
(Ryer, T. A.) 2 177
Crust
Atlantic Ocean
Iceland, oceanic type, Layer 2, Layer 3, boundary, intrusions, distribution, emplacement, controls
(Fridleifsson, I. V.) 11 1689
Mid-Atlantic Ridge, FAMOUS, oceanic, structure, experimental studies, laboratory studies, igneous rocks, metamorphic rocks, density, P-waves, velocity
(Schreiber, E., *et al.*) 4 600
Pacific Ocean
East Pacific Rise, oceanic, mid-ocean ridges, velocity structure, low-velocity zone, partial melting
(Reid, I., *et al.*) 5 678
United States
California, Transverse Ranges, structure, velocity structure, P-waves, anomalies, plate tectonics, boundary
(Hadley, D., *et al.*) 10 1469
Crystal growth
Framework silicates, feldspar group
Plagioclase, processes, controls, nucleation, rates, magmas, crystallization, lava lakes, Hawaii, Kilauea
(Kirkpatrick, R. J.) 1 78
Phosphates
Apatite, nodules, continental margin, phosphorite, genesis, Pacific Ocean, Chile, Peru
(Burnett, W. C.) 6 813
Silicates
Feldspar, zircon, overgrowths, relict materials, porphyroblasts, metamorphic rocks, Precambrian, Colorado
(Harris, R. L., Jr.) 12 1828

Cyprus
Sedimentary petrology
Sedimentation, controls, Tertiary, Troodos Massif
(Robertson, A. H. F.) 12 1763
Deformation
Field studies
Compaction, plasticity, ooids, limestone, Precambrian, Bhander Limestone, India
(Chanda, S. K., *et al.*) 11 1577
Fractures, cataclasis, gouge, shear zones, overthrust faults, displacements, sedimentary rocks, sandstone, Mesozoic, Aztec Sandstone, Nevada, Muddy Mountain Overthrust, Buffington Window
(Brock, W. G., *et al.*) 11 1667
Recrystallization, garnet, zoning, metamorphism, syntectonic, diachronism, Precambrian, Moinian, Scotland
(MacQueen, J. A., *et al.*) 2 235
Strain, markers, lapilli, ellipsoids, metamorphic rocks, metavolcanic, pyroclastics, automatic data processing, applications, models, orogenic belts, evolution, United States, California, Ritter Range
(Tobisch, O. T., *et al.*) 1 23
Strain, orientation, paths, calcite, crystal growth, folds, asymmetric, slaty cleavage, theoretical studies, models, computers, Cambrian, Conococheague Formation, Appalachians, Blue Ridge, Virginia
(Wickham, J., *et al.*) 7 920
Theoretical studies
Folds, boudinage, mullions, genesis, mechanism, materials, non-Newtonian
(Smith, R. B.) 2 312
Preferred orientation, minerals, grains, displacements, models, fabric
(Willis, D. G.) 6 883
Devonian
United States
Appalachians, Allegheny Front, biostratigraphy, Brachiopoda, range, boundary, upper Devonian, Frasnian, Famennian, Foreknobs Formation
(McGhee, G. R., Jr.) 6 806
New Hampshire, absolute age, time scales, New Hampshire Plutonic Series, Kinsman Quartz Monzonite, Bethlehem Gneiss, Spaulding Quartz Diorite, Concord Granite
(Lyons, J. B., *et al.*) 12 1808
Earthquakes
Atlantic Ocean
Mid-Atlantic Ridge, FAMOUS, detection, seismographs, ocean floors
(Francis, T. J. G., *et al.*) 5 664
Central America
Regional, shallow focus, magnitude, seismicity, geologic hazards, occurrence, fault zones, neotectonics, plate tectonics, Quaternary
(Carr, M. J., *et al.*) 1 151
United States
California, Mojave Desert, Galway Lake, active faults, rupture
(Hill, R. L., *et al.*) 10 1378
California, Nevada, patterns, characterization, discrimination, algorithms, automatic data processing, prediction
(Briggs, P., *et al.*) 2 161
Eastern Hemisphere
Structural geology
Tectonics, evolution, orogeny, Paleozoic, Africa, North Africa, Europe
(Arthaud, F., *et al.*) 9 1305
Ecology
United States
Georgia, marine environment, continental shelf, inner shelf, organic carbon, distribution, sand, Invertebrata, benthonic taxa
(Pinet, P. R., *et al.*) 12 1731
Ecuador
Geochemistry
Major elements, trace elements, volcanic rocks, tholeiite, Cretaceous, Eocene
(Goossens, P. J., *et al.*) 12 1711
Education
General
Curricula, field studies, innovations, Maclure, Eaton, history, 1825-1860, United States, New York, Rensselaer School, Indiana, New Harmony
(Johnson, M. E.) 8 1192
Energy sources
North America
Canada, Alaska, petroleum, uranium, resources, possibilities, future
(Folinsbee, R. E.) 7 897
Engineering geology
Earthquakes
Shallow focus, magnitude, geologic hazards, Central America
(Carr, M. J., *et al.*) 1 151
Materials, properties
Sediments, acoustical properties, continental margin, data, sonobuoys, statistical analysis, Atlantic Ocean, South America
(Houtz, R. E.) 5 720
Shorelines
Sedimentation, transport, deposition, patterns, rivers, mouths, deltas, theoretical studies
(Wright, L. D.) 6 857
England
Tectonophysics
Plate tectonics, northwest, Lake District
(Moseley, F.) 6 764
Environmental geology
Geologic hazards
Earthquakes, shallow focus, occurrence, magnitude, Central America
(Carr, M. J., *et al.*) 1 151
Ethiopia
Tectonophysics
Plate tectonics, geometry, Afar
(Barberi, F., *et al.*) 9 1251
Europe
Tectonophysics
Continental drift, Alps, Mediterranean region, Italy, Calabria, Sardinia, Corsica
(Chabrier, G., *et al.*) 11 1694
Faults
Displacements
Normal faults, active faults, neotectonics, Holocene, Arizona, Grand Canyon, Toroweap Fault, Hurricane Fault
(Huntoon, P. W.) 11 1619
Vertical faults, right-lateral faults, active faults, rupture, earthquakes, fault zones, nomenclature, California, Mojave Desert, Galway Lake fault zone
(Hill, R. L., *et al.*) 10 1378
Effects
Shear zones, gouge, fractures, cataclasis, overthrust faults, displacements, field studies, experimental studies, Mesozoic, Aztec Sandstone, United States, Nevada, Muddy Mountain Overthrust, Buffington Window
(Brock, W. G., *et al.*) 11 1667
Systems
Block faults, displacements, age, active faults, fault scarps, profiles, Quaternary, Nevada, north-central
(Wallace, R. E.) 9 1267
Evolution, Phanerozoic, United States, Alaska, Denali Fault
(Hickman, R. G., *et al.*) 9 1217
Folds
Distribution
Isoclinal, superposed, structural analysis, pendants, Paleozoic, Triassic, California, Sierra Nevada, Saddlebag Lake
(Brook, C. A.) 3 321

Orientation
Recumbent, nappes, large-scale, interpretation, Appalachians, Valley and Ridge Province, Alabama
(Roeder, D., *et al.*) 1 157
Style
Domes, isoclinal folds, recumbent folds, flexural-slip folds, structural analysis, interference patterns, Appalachians, Blue Ridge Province, Toxaway Dome
(Hatcher, R. D., Jr.) 11 1678
Foliation
Style
Cleavage, slip cleavage, axial-plane, layered, microstructure, mechanism, metamorphic rocks, metasedimentary, mica schist, Australia, South Australia, Macclesfield
(Marlow, P. C., *et al.*) 6 873
Foraminifera
Biostratigraphy
Planktonic, Paleocene, North Carolina
(Harris, W. B., *et al.*) 6 869
Zoning, planktonic, correlation, magnetic anomalies, reversals, faunal list, Cretaceous, Paleocene, Italy, Gubbio
(Premoli Silva, I.) 3 371
Globigerinacea
Pleistocene, Brunhes Epoch, Pacific Ocean, west, equatorial, biostratigraphy, paleoecology, paleoclimatology, cycles, *Globorotalia cultrata, Globigerinoides sacculifer, Globorotalia truncatulinoides, Globoquadrina conglomerata*
(Valencia, M. J.) 1 143
Paleoecology
Marine, communities, mass extinction, paleo-oceanography, salinity, halite, volume, Permian
(Stevens, C. H.) 1 133
Geochronology
Fission-track
Sedimentary rocks, coal, volcanic ash, partings, zircon, dates, Miocene, Alaska, Kenai Peninsula
(Triplehorn, D. M., *et al.*) 8 1156
Paleomagnetism
Zoning, reversals, correlation, magnetic anomalies, marine, Cretaceous, Italy, Gubbio
(Lowrie, W., *et al.*) 3 374
Zoning, reversals, correlation, magnetic anomalies, marine, Cretaceous, Paleocene, Italy, Gubbio
(Roggenthen, W. M., *et al.*) 3 378
Tephrochronology
Soils, layers, tephra, absolute age, C-14, igneous rocks, volcanic, trace elements, Holocene, California, east, Mono Craters, Inyo Craters
(Wood, S. H.) 1 89
Time scales
Cretaceous, Paleocene, paleomagnetism, reversals, zoning, type section, Italy, Gubbio
(Alvarez, W., *et al.*) 3 383
Devonian, absolute age, Sr/Rb, plutonic rocks, New Hampshire
(Lyons, J. B., *et al.*) 12 1808
Miocene, Pliocene, boundary, paleomagnetism, absolute age, K/Ar, correlation, Iceland, west
(McDougall, I., *et al.*) 1 1
Geology
Education
Curricula, field studies, innovations, Maclure, Eaton, history, 1825-1860, United States
(Johnson, M. E.) 8 1192
Geomorphology
Concepts
Statistical methods, allometry, applications, landform description
(Cox, N. J., *et al.*) 8 1199
Eolian features
Dunes, sand plains, sedimentation, Pleistocene, Wisconsinan, New York, Albany
(Donahue, J. J.) 12 1756
Fluvial features
Drainage basins, channels, response, catastrophic, observations, concepts, Wolman, Miller, floods, magnitude, frequency, Texas, central
(Baker, V. R.) 8 1057
Drainage patterns, channel geometry, hydraulic geometry, stream order, statistical analysis, multivariate analysis, concepts, Leopold, Miller, Wisconsin, Pecatonica River
(Miller, T. K., *et al.*) 1 85
Drainage patterns, channel geometry, statistical analysis, sedimentation, hydrology, New South Wales, Styx River, Wollomombi River
(Gregory, K. J.) 8 1075
Drainage patterns, valleys, photogeology, aerial photography, areal geology, Mexico, Sonora, coastal
(Gastil, R. G., *et al.*) 2 189
Rivers, meanders, sinuosity, statistical analysis
(Ferguson, R. I.) 2 212
Streams, channel geometry, quantitative geomorphology, theoretical studies, concepts, minimum variance, Langbein
(Knighton, A. D.) 3 364
Streams, steps, stream segments, stream profiles, channels, ephemeral streams, sediments, granulometry, Middle East, Israel, Jordan, Dead Sea region
(Bowman, D.) 2 291
Landform description
Fault scarps, rupture, earthquakes, California, Mojave Desert, Galway Lake
(Hill, R. L., *et al.*) 10 1378
Hillslopes, variations, relation, environment, climate, data, statistical analysis, regression analysis, surveys, traverses, United States, regional
(Toy, T. J.) 1 16
Landform evolution
Fault scarps, profiles, erosion, displacements, age, Quaternary, United States, Nevada, north-central
(Wallace, R. E.) 9 1267
Topography, fault scarps, alluvium, lava, active faults, neotectonics, Holocene, Arizona, Grand Canyon, Toroweap Fault, Hurricane Fault
(Huntoon, P. W.) 11 1619
Processes
Erosion, sedimentation, streams, field studies, pebbles, transport, monitoring, floods, United States, Wyoming, west, Horse Creek
(Butler, P. R.) 8 1072
Erosion, weathering, alluvial fans, size, variations, statistical analysis, linear regression, source areas, bedrock, rocks, types, erodibility, United States, California, Death Valley
(Hooke, R. L., *et al.*) 8 1177
Shore features
Barrier islands, genesis, continental shelf, inner shelf, Holocene, United States, Atlantic Coastal Plain
(Otvos, E. G., Jr., *et al.*) 5 734
Terraces, correlation, age, evolution, erosion, biostratigraphy, changes of level, neotectonics, Pleistocene, California, San Diego
(Kern, J. P.) 11 1553
Volcanic features
Calderas, complexes, Miocene, Nevada, south, Timber Mountain, Oasis Valley
(Christiansen, R. L., *et al.*) 7 943
Craters, calderas, channels, comparison, Mars, observations, remote sensing, satellite, Landsat, Africa, Chad, Tibesti Massif
(Malin, M. C.) 7 908
Craters, tuff, channels, U-shaped, erosion, base surges, Hawaii, Oahu, Koko Crater
(Fisher, R. V.) 9 1287
Geophysical methods
Radioactivity methods
Applications, bedrock, structures, lithology, surficial geology, sediments, glacial, airborne, maps, patterns, United States,

Connecticut, Rhode Island, New York
(Goldsmith, R., *et al.*) 7 925

Geophysical surveys
Acoustical surveys
Arctic Ocean, Barents Sea, Atlantic Ocean, Norwegian Sea, marine, sonobuoys, continental margin, sediments, thickness, data, statistical analysis, sedimentation, deltas, Tertiary
(Houtz, R., *et al.*) 7 1030
Gravity surveys
United States, Pennsylvania, Newark-Gettysburg Basin, ground, profiles, basins, structure, faults, Bouguer anomalies, maps
(Sumner, J. R.) 7 935
Magnetic surveys
Atlantic Ocean, Mid-Atlantic Ridge, FAMOUS, marine, deep-tow, magnetic anomalies, sea-floor spreading
(Macdonald, K. C.) 4 541
Seismic surveys
Africa, South Africa, Agulhas Plateau, Agulhas Basin, marine, profiles, bottom features, topography, crust, structure, oceanic, plate tectonics
(Barrett, D. M.) 6 749
Atlantic Ocean, Brazil, continental margin, refraction, marine, crust, oceanic, structure, sediments, thickness, basement
(Houtz, R. E., *et al.*) 5 711
Atlantic Ocean, Mid-Atlantic Ridge, FAMOUS, marine, seismographs, ocean floors, mid-ocean ridges, seismicity, earthquakes
(Francis, T. J. G., *et al.*) 5 664
Indian Ocean, Agulhas Plateau, marine methods, ocean floors, plateaus, sedimentation
(Tucholke, B. E., *et al.*) 9 1337
Pacific Ocean, East Pacific Rise, refraction, profiles, mid-ocean ridges, low-velocity zone
(Reid, I., *et al.*) 5 678
Pacific Ocean, Juan de Fuca Ridge, reflection, marine, structure, spreading centers, median valleys
(Davis, E. E., *et al.*) 3 346
Surveys
Arctic Ocean, Barents Sea, seismic surveys, reflection, refraction, acoustical surveys, sonobuoys, marine, structure, sediments, thickness
(Eldholm, O., *et al.*) 7 1015
Indian Ocean, Australia, Great Australian Bight, marine, profiles, gravity surveys, magnetic surveys, bathymetry, seismic surveys, reflection, refraction, continental margin, gravity anomalies, magnetic anomalies, quiet zones, crust
(Koenig, M., *et al.*) 7 1000
Mediterranean Sea, Crete, Pliny Trench, Strabo Trench, acoustical surveys, seismic surveys, reflection, marine, profiles, bathymetry, structure, shallow, trenches, subduction
(Jongsma, D.) 6 797

Georgia
Geochemistry
Organic materials, carbon, sand, Sapelo Island, Doboy Sound, Altamaha Sound
(Pinet, P. R., *et al.*) 12 1731

Glacial geology
Glacial features
Till, basal till, fabric, clasts, size, shape, orientation, glaciers, alpine, modern, Washington, Alberta
(Mills, H. H.) 6 824
Glaciation
Deglaciation, ice movement, stagnation, models, Pleistocene, Wisconsinan, New England, Connecticut
(Black, R. F.) 9 1331
Deglaciation, moraines, extent, mapping, drift, till, fabric, drumlins, distribution, Pleistocene, Wisconsinan, New York, Mohawk Valley
(Krall, D. B.) 12 1697
Deposition, ice-rafting, changes, Quaternary, Atlantic Ocean, North Atlantic
(Ruddiman, W. F.) 12 1813
Extent, erosion, till, textures, lithology, glacial features, eskers, kames, cirques, Pleistocene, Wisconsinan, Maine, west-central
(Borns, H. W., Jr., *et al.*) 12 1773
Extent, till, drift, Pleistocene, Holocene, Oregon, Cascade Range, Metolius River region
(Scott, W. E.) 1 113
Glaciers
Alpine, drift, textures, environmental analysis, Quaternary, United States, Washington, Nisqually Glacier, Paradise Glacier, South Cascade Glacier, Canada, Alberta, Athabasca Glacier
(Mills, H. H.) 8 1135

Greenland
Tectonophysics
Plate tectonics, geometry
(Kristoffersen, Y., *et al.*) 7 1037

Ground water
Aquifers
United States, New York, Long Island, South Fork, concepts, yield, safe yield, recharge, water resources, management
(Anderson, M. P., *et al.*) 6 895

Gulf Coastal Plain
Geochemistry
Isotopes, oxygen, shale, Texas, Louisiana, Gulf of Mexico
(Yeh, H.-W., *et al.*) 9 1321

Hawaii
Geochronology
Absolute age, Holocene, Oahu, Hanauma Reef
(Stearns, H. T., *et al.*) 10 1535
Absolute age, Quaternary, Lanai
(Bonhommet, N., *et al.*) 9 1282
Mineralogy
Framework silicates, feldspar group, plagioclase, Kilauea, Makaopuhi Crater, Alae Crater
(Kirkpatrick, R. J.) 1 78
Sedimentary petrology
Sedimentary rocks, tuff, sedimentary structures, Quaternary, Oahu, Koko Crater
(Fisher, R. V.) 9 1287

Heat flow
Atlantic Ocean
Mid-Atlantic Ridge, FAMOUS, measurement, data, faults, transform, crust, oceanic, hydrothermal processes, sea-floor spreading
(Williams, D. L., *et al.*) 4 531

Holocene
Pacific Ocean
North Pacific, Nitinat Fan, sedimentation, deep-sea environment, upper Holocene
(Stokke, P. R., *et al.*) 11 1586
United States
Arizona, Grand Canyon, neotectonics, faults
(Huntoon, P. W.) 11 1619
California, east, Mono Craters, Inyo Craters, tephrochronology, volcanism, upper Holocene
(Wood, S. H.) 1 89
California, Santa Barbara Basin, paleoclimatology, sedimentation, sedimentary structures, modern, 19th century, 20th century
(Soutar, A., *et al.*) 8 1161
Hawaii, Hanauma Reef, absolute age, changes of level, upper Holocene
(Stearns, H. T., *et al.*) 10 1535

Hydrology
Rivers and streams
Australia, New South Wales, Styx River, Wollomombi River, channel geometry, drainage patterns, statistical analysis, sedimentation
(Gregory, K. J.) 8 1075

Hydraulics, hydraulic geometry, theoretical studies, concepts, minimum variance, Langbein
(Knighton, A. D.) 3 364
South America, Brazil, Amazon River, United States, Alaska, Yukon River, transition metals, mass transport, applications, pollution
(Gibbs, R. J.) 6 829
United States, Texas, central, floods, magnitude, frequency, concepts, Wolman, Miller, observations, channels, response, catastrophic
(Baker, V. R.) 8 1057
United States, Wisconsin, Pecatonica River, drainage basins, drainage patterns, hydraulic geometry, stream order, statistical analysis, multivariate analysis, concepts, Leopold, Miller
(Miller, T. K., *et al.*) 1 85
United States, Wyoming, Shoshone River, North Fork, drainage basins, runoff, precipitation, storms, geochemistry, hydrochemistry, data, statistical analysis, factor analysis, R-mode, minerals, ferromagnesian, weathering, potassium, leaching
(Miller, W. R., *et al.*) 2 286

Iceland

Petrology

Intrusions, distribution
(Fridleifsson, I. V.) 11 1689

Igneous rocks

Alkalic

Basalt, hawaiite, mugearite, phonolite, syenite, trachyte, rhyolite, petrology, composition, data, genesis, magmas, Cenozoic, Texas, New Mexico, Trans-Pecos magmatic province, Kenya, Kenya Rift valley
(Barker, D. S.) 10 1421
Volcanic, absolute age, chemical composition, data, continental drift, plate tectonics, Jurassic, Cretaceous, Tertiary, Brazil, Atlantic Ocean, South Atlantic
(Herz, N.) 1 101

Basalt family

Basalt, chemical composition, trace elements, potassium, rubidium, cesium, barium, rare earths, isotopes, strontium, ratios, data, genesis, partial melting, magmas, differentiation, Atlantic Ocean, Mid-Atlantic Ridge, FAMOUS
(White, W. M., *et al.*) 4 571
Basalt, magnetic properties, experimental studies, samples, dredged, Atlantic Ocean, Mid-Atlantic Ridge, FAMOUS
(Johnson, H. P., *et al.*) 5 637
Tholeiite, geochemistry, affinities, chemical composition, major elements, trace elements, petrography, data, Cretaceous, Eocene, South America, Ecuador, Colombia, Central America, Panama
(Goossens, P. J., *et al.*) 12 1711
Tholeiite, lava flows, petrography, chemical composition, modal analysis, absolute age, data, Quaternary, Hawaii, Lanai
(Bonhommet, N., *et al.*) 9 1282

Composition

Chemical composition, major elements, trace elements, rare earths, isotopes, data, genesis, absolute age, complexes, gabbro, diorite, lamprophyre, syenite, porphyry, Tertiary, Paleogene, India, Girnar
(Paul, D. K., *et al.*) 2 227
Mineral composition, data, intrusions, Cenozoic, United States, Texas, New Mexico, Trans-Pecos magmatic province, Diablo Platform
(Barker, D. S., *et al.*) 10 1428

Genesis

Magmas, contact, limestone, assimilation, mafic composition, ultramafic composition, pyroxenite, nepheline pyroxenite, syenite, nepheline syenite, Texas, Christmas Mountains
(Joesten, R.) 10 1515

Granite-granodiorite family

Granite, aplite, calc-alkalic composition, petrography, textures, composition, paragenesis, geochemistry, isotopes, strontium, data, distribution, genesis, island arcs, Arabian Peninsula, Saudi Arabia
(Nasseef, A. O., *et al.*) 12 1721
Quartz monzonite, textures, petrography, composition, data, genesis, models, magmas, partial melting, Precambrian, Colorado, Mosquito Range, Treasurevault Stock
(Kuntz, M. A., *et al.*) 3 465

Plutonic

Petrology, textures, geochemistry, isotopes, rubidium, strontium, absolute age, intrusions, magmas, genesis, Tertiary, Texas, New Mexico, Trans-Pecos magmatic province, Diablo Platform
(Barker, D. S., *et al.*) 10 1437

Properties

Physical properties, elastic properties, density, P-waves, velocity, experimental studies, laboratory studies, pressure, basalt, tholeiite, textures, crust, oceanic, Atlantic Ocean, Mid-Atlantic Ridge, FAMOUS
(Schreiber, E., *et al.*) 4 600

Pyroclastics and glasses

Basalt glass, geochemistry, major elements, trace elements, data, globules, sulfide, phase equilibria, Atlantic Ocean, Mid-Atlantic Ridge, FAMOUS
(Czamanske, G. K., *et al.*) 4 587

Ultramafic family

Ophiolite, complexes, genesis, models, plate tectonics, Canada, Newfoundland, west
(Dewey, J. F., *et al.*) 7 960
Ophiolite, complexes, genesis, plate tectonics, obduction, models, Cretaceous, Oman, Oman Mountains
(Gealey, W. K.) 8 1183
Ophiolite, complexes, genesis, plate tectonics, subduction, models, Cretaceous, Oman, Oman Mountains
(Welland, M. J. P., *et al.*) 8 1081
Ophiolite, textures, field studies, genesis, emplacement, thrust plates, complexes, Paleozoic, Triassic, California, Klamath Mountains, Preston Peak
(Snoke, A. W.) 11 1641
Peridotite, genesis, deserpentinization, metamorphism, prograde, data, petrography, field studies, United States, Washington, Cascade Range
(Vance, J. A., *et al.*) 10 1497

Volcanic

Alkali basalt, ankaratrite, basanite, basalt, olivine basalt, inclusions, xenoliths, peridotite, petrography, textures, composition, intrusions, plugs, Tertiary, Brazil, northeast
(Sial, A. N.) 8 1173
Basalt, dolerite, syenite, lava, pillow lava, lava flows, petrography, chemical composition, mineral composition, data, plate tectonics, stratigraphy, Cretaceous, Cenozoic, Solomon Islands, Malaita
(Hughes, G. W., *et al.*) 3 412
Distribution, metallogeny, plate tectonics, Tertiary, Nevada, Utah
(Stewart, J. H., *et al.*) 1 67
Lava, ash flows, andesite, basalt, glass, calc-alkalic composition, mineral composition, chemical composition, petrography, geologic thermometry, data, genesis, magmas, mafic composition, partial melting, subduction, Cenozoic, Utah, southwest
(Hausel, W. D., *et al.*) 12 1831
Lava flows, basalt, basalt glass, chemical composition, mineral composition, data, models, median valleys, magma chambers, Atlantic Ocean, Mid-Atlantic Ridge, FAMOUS
(Bryan, W. B., *et al.*) 4 556
Tuff, rhyolite, lava flows, ash flows, composition, geochemistry, data, magmas, differentiation, Miocene, Nevada, south
(Christiansen, R. L., *et al.*) 7 943

Inclusions

Xenoliths

Peridotite, host materials, alkali basalt, basalt, textures, petrography, chemical composition, genesis, depth, temperature, data, Tertiary, Brazil, northeast
(Sial, A. N.) 8 1173
Peridotite, spinel peridotite, host materials, igneous rocks, alkali basalt, petrography, composition, mineral composition, zoning, data, genesis, partial melting, mantle, Pliocene, Quaternary,

Mediterranean region, Sardinia
(de Albuquerque, C. A. R., *et al.*) 10 1493

India
Geochemistry
Isotopes, strontium, oxygen, major elements, trace elements, rare earths, igneous rocks, complexes, west-central, Deccan Province, Girnar
(Paul, D. K., *et al.*) 2 227
Sedimentary petrology
Sedimentary rocks, carbonate rocks, sedimentation, diagenesis, Precambrian, Bhander Limestone, central, Maihar
(Chanda, S. K., *et al.*) 11 1577

Indian Ocean
Geophysical surveys
Surveys, Australia, Great Australian Bight
(Koenig, M., *et al.*) 7 1000
Oceanography
Sedimentation, ocean floors, Agulhas Plateau
(Tucholke, B. E., *et al.*) 9 1337
Tectonophysics
Plate tectonics, evolution, Ninetyeast Ridge, Broken Ridge Plateau, Naturaliste Plateau, Kerguelen Plateau
(Luyendyk, B. P., *et al.*) 9 1347

Intrusions
Age
Absolute age, batholiths, stocks, Mesozoic, Oregon, Washington, Idaho
(Armstrong, R. L., *et al.*) 3 397
Absolute age, complexes, emplacement, Oligocene, Miocene, Washington, Tatoosh Intrusion
(Mattinson, J. M.) 10 1509
Batholiths
Structure, density, Bouguer anomalies, magnetic anomalies, profiles, mapping, California, Sierra Nevada Batholith
(Oliver, H. W.) 3 445
Composition
Mineral composition, Cenozoic, Texas, New Mexico, Trans-Pecos magmatic province, Diablo Platform
(Barker, D. S., *et al.*) 10 1428
Distribution
Controls, emplacement, magma chambers, size, shape, country rocks, lithology, soft materials, crust, oceanic type, Layer 2, Layer 3, boundary, igneous rocks, basalt, Iceland
(Fridleifsson, I. V.) 11 1689
Petrology
Sills, laccoliths, sheets, textures, geochemistry, absolute age, metamorphism, contact metamorphism, Tertiary, Texas, New Mexico, Trans-Pecos magmatic province, Diablo Platform
(Barker, D. S., *et al.*) 10 1437
Stocks
Petrology, genesis, quartz monzonite, Precambrian, Colorado, Mosquito Range, Treasurevault Stock
(Kuntz, M. A., *et al.*) 3 465

Invertebrata
Biogeography
Concepts, genera, commonality, continental drift, orogeny, plate tectonics, Phanerozoic, Atlantic region, North America, Europe, North Africa
(Fallaw, W. C.) 1 62
Paleoecology
Marine, communities, mass extinction, paleo-oceanography, salinity, halite, volume, Permian
(Stevens, C. H.) 1 133

Iron
Abundance
Saprolite, estimation, visual, minerals, iron oxides, samples, United States, Georgia
(Hurst, V. J.) 2 174

Isotopes
Lead
Ratios, metamorphic rocks, zircon, absolute age, interpretation, discordance, radioactive isotopes, diffusion, Paleozoic, Glenarm Series, Appalachians, Piedmont
(Higgins, M. W., *et al.*) 1 125
Oxygen
O-18/O-16, fractionation, geologic thermometry, burial metamorphism, diagenesis, shale, analysis, data, Gulf Coastal Plain, Gulf of Mexico
(Yeh, H.-W., *et al.*) 9 1321
Strontium
Sr-87/Sr-86, absolute age, igneous rocks, granitic, Mesozoic, Oregon, Washington, Idaho
(Armstrong, R. L., *et al.*) 3 397
Sr-87/Sr-86, analysis, data, basalt, Atlantic Ocean, Mid-Atlantic Ridge, FAMOUS
(White, W. M., *et al.*) 4 571
Sr-87/Sr-86, ratios, absolute age, data, gneiss, igneous rocks, granitic, Precambrian, Wyoming, Sierra Madre
(Divis, A. F.) 1 96

Israel
Geomorphology
Fluvial features, Dead Sea region
(Bowman, D.) 2 291

Italy
Geochronology
Paleomagnetism, Cretaceous, Apennines, Umbria, Gubbio
(Lowrie, W., *et al.*) 3 374
Paleomagnetism, Cretaceous, Paleocene, Apennines, Umbria, Gubbio
(Roggenthen, W. M., *et al.*) 3 378
Time scales, Cretaceous, Paleocene, Apennines, Umbria, Gubbio
(Alvarez, W., *et al.*) 3 383
Sedimentary petrology
Sedimentary rocks, lithostratigraphy, sedimentation, rates, Cretaceous, Paleocene, Apennines, Umbria, Gubbio
(Arthur, M. A., *et al.*) 3 367
Stratigraphy
Cretaceous, Paleocene, biostratigraphy, foraminifera, Apennines, Umbria, Gubbio
(Premoli Silva, I.) 3 371

Jordan
Geomorphology
Fluvial features, Dead Sea region
(Bowman, D.) 2 291

Jurassic
South America
Brazil, absolute age, igneous rocks, alkalic, plate tectonics, continental drift
(Herz, N.) 1 101
United States
Oregon, sedimentation, upper Jurassic, Otter Point Formation, Dothan Formation
(Walker, R. G.) 2 273

Kenya
Petrology
Igneous rocks, alkalic composition, magmas, Cenozoic, Kenya Rift valley
(Barker, D. S.) 10 1421

Lava
Age
Absolute age, lava flows, tholeiite, Quaternary, Hawaii, Lanai
(Bonhommet, N., *et al.*) 9 1282
Composition
Chemical composition, mineral composition, basalt, glass, median valleys, magma chambers, models, Atlantic Ocean, Mid-Atlantic Ridge, FAMOUS
(Bryan, W. B., *et al.*) 4 556

Petrology
Miocene, Nevada, south
(Christiansen, R. L., *et al.*) 7 943

Lead
Mexico
Coahuila, ore deposits, mineralization, structural controls, host rocks, limestone, structure, stratigraphy, Cretaceous
(Lozej, G. P., *et al.*) 12 1793

Lineation
Style
Boudinage, mullions, genesis, mechanism, theoretical studies, materials, non-Newtonian
(Smith, R. B.) 2 312

Magmas
Differentiation
Igneous rocks, alkalic composition, genesis, Cenozoic, United States, Texas, New Mexico, Trans-Pecos magmatic province, Africa, Kenya
(Barker, D. S.) 10 1421
Intrusions, Tertiary, Texas, New Mexico, Trans-Pecos magmatic province, Diablo Platform
(Barker, D. S., *et al.*) 10 1437
Genesis
Nepheline pyroxenite, nepheline syenite, metasomatism, wallrock alteration, contact, sedimentary rocks, limestone, assimilation, United States, Texas, Christmas Mountains
(Joesten, R.) 10 1515

Maine
Geomorphology
Glacial geology, glaciation, west-central, Franklin County, Oxford County
(Borns, H. W., Jr., *et al.*) 12 1773

Mantle
United States
California, Transverse Ranges, upper mantle, structure, velocity structure, P-waves, anomalies, plate tectonics, boundary
(Hadley, D., *et al.*) 10 1469

Maps
Cartography
Radioactivity, airborne, patterns, applications, bedrock, structures, lithology, surficial geology, sediments, glacial, Connecticut, Rhode Island, New York
(Goldsmith, R., *et al.*) 7 925
South America
Peru, geologic maps
(Hollister, V. F.) 12 1749
United States
California, Klamath Mountains, Preston Peak, geologic maps
(Snoke, A. W.) 11 1641
Nevada, New York Mountains, geologic maps
(Burchfiel, B. C., *et al.*) 11 1623

Marine geology
Atlantic Ocean
North Atlantic, United States, North Carolina, continental shelf, sedimentation, bathymetry, acoustical surveys, sonar, side-scanning
(Hunt, R. E., *et al.*) 2 299

Mars
Geomorphology
Volcanic features, craters, calderas, channels, comparison, terrestrial, observations, Mariner 9
(Malin, M. C.) 7 908

Maryland
Petrology
Metamorphic rocks, migmatite, metamorphism, Precambrian, Baltimore Gneiss, Baltimore County, Baltimore, Piney Creek
(Olsen, S. N.) 8 1089

Mathematical geology
Methods
Orientation tensors, eigenvalues, fabric, shape, applications, structural analysis, paleomagnetism, sedimentary petrology, glacial geology
(Woodcock, N. H.) 9 1231

Mediterranean Sea
Geophysical surveys
Surveys, east, Europe, Greece, Hellenic Arc, Crete, Pliny Trench, Strabo Trench
(Jongsma, D.) 6 797

Mesozoic
Northern Hemisphere
Regional, paleoclimatology, paleogeography, continental drift, polar wandering
(Donn, W. L., *et al.*) 3 390
Southern Hemisphere
Australasia, New Zealand, Antarctica, Australia, Gondwana, continental drift, paleogeography, interpretation
(Griffiths, J. R., *et al.*) 8 1203
United States
California, Mojave Desert, tectonics
(Dunne, G. C.) 6 737
Nevada, southeast, metamorphic rocks, stratigraphy, correlation, tectonics
(Burchfiel, B. C., *et al.*) 11 1623
Oregon, Washington, Idaho, igneous activity, intrusions, absolute age
(Armstrong, R. L., *et al.*) 3 397

Metals
Abundance
Rivers, suspended materials, transition metals, chromium, manganese, iron, cobalt, nickel, copper, depletion, enrichment, mass transport, particles, coatings, data, applications, environmental geology, pollution, South America, Amazon River, Alaska, Yukon River
(Gibbs, R. J.) 6 829
Geochemistry
Sediments, ocean floors, Pacific Ocean, southeast
(Heath, G. R., *et al.*) 5 723
North America
Canada, Alaska, ore deposits, resources, possibilities, future
(Folinsbee, R. E.) 7 897
United States
Nevada, Utah, ore deposits, distribution, patterns, magnetic anomalies, airborne, igneous activity, volcanism, plate tectonics, Tertiary
(Stewart, J. H., *et al.*) 1 67

Metamorphic rocks
Distribution
Complexes, mafic composition, ultramafic composition, alpine-type, Paleozoic, Triassic, United States, California, Klamath Mountains, Preston Peak
(Snoke, A. W.) 11 1641
Metasedimentary
Metaconglomerate, clasts, blueschist facies, interpretation, metamorphism, contact, metasomatism, Mesozoic, United States, California, Franciscan Belt, Diablo Range
(Bloxam, T. W., *et al.*) 3 480
Textures, petrofabrics, minerals, garnet, crystal growth, metamorphism, syntectonic, diachronism, Precambrian, Moinian, Scotland, west, Caledonian Belt
(MacQueen, J. A., *et al.*) 2 235
Metavolcanic
Metabasalt, tholeiite, chemical composition, major elements, trace elements, data, genesis, plate tectonics, rifting, abyssal environment, island arcs, regional metamorphism, Taconic Orogeny, Ordovician, Ammonoosuc Volcanics, Vermont, New Hampshire, Connecticut Valley
(Aleinikoff, J. N.) 11 1546

Migmatites
Migmatite, composition, classification, nomenclature, genesis, metamorphism, anatexis, migmatization, data, Precambrian, Baltimore Gneiss, United States, Maryland, Baltimore, Piney Creek
(Olsen, S. N.) 8 1089
Petrology
Amphibolite, gneiss, distribution, petrography, textures, mineral assemblages, Saudi Arabia
(Nasseef, A. O., *et al.*) 12 1721
Metamorphism
Burial
P-T conditions, temperature, isotopes, oxygen, argillaceous rocks, shale, cores, Gulf Coastal Plain, Gulf of Mexico
(Yeh, H.-W., *et al.*) 9 1321
Contact
Skarn, nepheline pyroxenite, genesis, limestone, assimilation, Texas, Christmas Mountains
(Joesten, R.) 10 1515
Grade
High-grade metamorphism, mineral assemblages, metamorphic rocks, structural analysis, age, absolute age, Oligocene, Miocene, Utah, northwest
(Compton, R. R., *et al.*) 9 1237
Mechanism
Migmatization, anatexis, differentiation, migmatite, Precambrian, Baltimore Gneiss, Maryland, Baltimore, Piney Creek
(Olsen, S. N.) 8 1089
Prograde
Igneous rocks, ultramafic composition, peridotite, genesis, serpentinization, deserpentinization, petrography, field studies, metamorphic rocks, serpentinite, Washington, Cascade Range
(Vance, J. A., *et al.*) 10 1497
Regional
Syntectonic, diachronism, garnet, crystal growth, metamorphic rocks, metasedimentary, deformation, structural analysis, Precambrian, Moinian, Scotland, west, Caledonian Belt
(MacQueen, J. A., *et al.*) 2 235
Mexico
Areal geology
Structural geology, petrology, geochronology, geomorphology, Sonora, Lobos, Kino, Tiburon Island, Gulf of California
(Gastil, R. G., *et al.*) 2 189
Economic geology
Lead, silver, Coahuila, La Encantada Mine
(Lozej, G. P., *et al.*) 12 1793
Geochronology
Absolute age, Oligocene, Miocene, Sierra Madre Occidental, Durango, Mazatlan
(McDowell, F. W., *et al.*) 10 1479
Michigan
Soils
Soil group, paleosols, Precambrian, north
(Lewan, M. D., *et al.*) 9 1375
Mineral deposits, genesis
Controls
Structural controls, fractures, host rocks, limestone, ore deposits, lead, silver, Mexico, Coahuila
(Lozej, G. P., *et al.*) 12 1793
Minerals
Framework silicates, feldspar group
Plagioclase, crystal growth, lava lakes, United States, Hawaii, Kilauea
(Kirkpatrick, R. J.) 1 78
Miscellaneous minerals
Silicates, feldspar, nepheline, zeolites, analcime, olivine, clinopyroxene, amphibole, biotite, oxides, intrusions, Cenozoic, Texas, New Mexico, Trans-Pecos magmatic province, Diablo Platform
(Barker, D. S., *et al.*) 10 1428
Oxides
Hematite, goethite, optical properties, iron, estimation, visual, saprolite, color, weathering, samples, Georgia
(Hurst, V. J.) 2 174
Phosphates
Apatite, crystal growth, nodules, continental margin, phosphorite, genesis, Pacific Ocean, Chile, Peru
(Burnett, W. C.) 6 813
Silicates
Feldspar, zircon, crystal growth, overgrowths, relict materials, porphyroblasts, metamorphic rocks, gneiss, Precambrian, United States, Colorado
(Harris, R. L., Jr.) 12 1828
Miocene
Atlantic Ocean
Iceland, west, stratigraphy, correlation, geochronology, time scales, paleomagnetism, absolute age, boundary, upper Miocene
(McDougall, I., *et al.*) 1 1
Mexico
Sierra Madre Occidental, absolute age, volcanism
(McDowell, F. W., *et al.*) 10 1479
Pacific Ocean
North Pacific, sediments, lower Miocene
(Vallier, T. L., *et al.*) 6 787
United States
Alaska, Kenai Peninsula, coal, geochronology, fission-track, absolute age, stratigraphy, boundary, age, revision, Homerian, Clamgulchian, Kenai Group
(Triplehorn, D. M., *et al.*) 8 1156
Nevada, south, volcanism, petrology
(Christiansen, R. L., *et al.*) 7 943
Utah, northwest, tectonics, metamorphism, absolute age
(Compton, R. R., *et al.*) 9 1237
Washington, Tatoosh Intrusion, absolute age
(Mattinson, J. M.) 10 1509
Mississippi
Geochronology
Absolute age, Cretaceous, west-central, Humphreys County
(Sundeen, D. A., *et al.*) 8 1144
Mississippian
United States
Oklahoma, Arkansas, Ouachita Mountains, volcanism, pyroclastics, sedimentation, lithostratigraphy, sections, correlation, Stanley Group, Beavers Bend Tuff, Hatton Tuff
(Niem, A. R.) 1 49
Mollusca
Biostratigraphy
Terraces, changes of level, faunal list, Pleistocene, California, San Diego
(Kern, J. P.) 11 1553
Moon
Age
Relative age, surface materials, techniques, craters, morphology, distribution, size, diameters, erosion, degradation
(McGill, G. E.) 8 1102
Nevada
Geomorphology
Landform evolution, faults, north-central, Pershing County, Churchill County
(Wallace, R. E.) 9 1267
Petrology
Volcanology, volcanism, igneous rocks, lava, Miocene, south, Nye County, Timber Mountain, Oasis Valley
(Christiansen, R. L., *et al.*) 7 943
Seismology
Earthquakes, regional
(Briggs, P., *et al.*) 2 161
Stratigraphy
Silurian, Devonian, biostratigraphy, Great Basin
(Johnson, J. G., *et al.*) 10 1462

Structural geology
Deformation, faults, southeast, Clark County, Muddy Mountain Overthrust, Buffington Window
(Brock, W. G., *et al.*) 11 1667
Tectonics, southeast, Clark County, New York Mountains, Sagamore Canyon, Slaughterhouse Spring
(Burchfiel, B. C., *et al.*) 11 1623
Tectonics, structure
(Stewart, J. H., *et al.*) 1 67
Tectonics, structure, west, Lyon County, Yerington District, Basin and Range Province
(Proffett, J. M., Jr.) 2 247

New Hampshire
Geochemistry
Major elements, trace elements, metavolcanic rocks, Ordovician, Ammonoosuc Volcanics, Grafton County, Connecticut Valley
(Aleinikoff, J. N.) 11 1546
Geochronology
Time scales, absolute age, Devonian, Merrimack County, Sullivan County, Grafton County
(Lyons, J. B., *et al.*) 12 1808

New Mexico
Petrology
Igneous rocks, composition, intrusions, Cenozoic, Otero County, Diablo Platform
(Barker, D. S., *et al.*) 10 1428
Igneous rocks, plutonic rocks, intrusions, magmas, Tertiary, Otero County, Diablo Platform
(Barker, D. S., *et al.*) 10 1437
Stratigraphy
Quaternary, biostratigraphy, paleoecology, paleoclimatology, northwest, San Juan County, Chaco Canyon National Monument
(Hall, S. A.) 11 1593

New South Wales
Geomorphology
Fluvial features, Styx River, Wollomombi River
(Gregory, K. J.) 8 1075

New York
Geomorphology
Glacial geology, glaciation, east-central, Otsego County, Madison County, Oneida County, Mohawk Valley
(Krall, D. B.) 12 1697
Geophysical surveys
Radioactivity methods, Suffolk County, Fishers Island
(Goldsmith, R., *et al.*) 7 925
Hydrogeology
Ground water, aquifers, Suffolk County, Long Island, South Fork
(Anderson, M. P., *et al.*) 6 895
Sedimentary petrology
Sedimentation, transport, Pleistocene, Hudson Valley, Albany County, Albany
(Donahue, J. J.) 12 1756
Stratigraphy
Quaternary, biostratigraphy, Invertebrata, Long Island, New York City, Kings County, Brooklyn
(Blank, H. R., *et al.*) 1 159

New Zealand
Tectonophysics
Continental drift, Mesozoic
(Griffiths, J. R., *et al.*) 8 1203

Newfoundland
Tectonophysics
Plate tectonics, geometry, west
(Dewey, J. F., *et al.*) 7 960

Nodules
Phosphate
Geochemistry, composition, growth, structure, data, models, phosphorite, genesis, continental margin, Pacific Ocean, Chile, Peru
(Burnett, W. C.) 6 813

North America
Economic geology
Energy sources, metals, Canada, United States, Alaska
(Folinsbee, R. E.) 7 897
Sedimentary petrology
Sediments, till, Holocene, United States, Washington, Mount Rainier, Paradise Glacier, South Cascade Glacier, Canada, Alberta, Athabasca Glacier
(Mills, H. H.) 6 824
Tectonophysics
Plate tectonics, west, North American Cordillera
(Churkin, M., Jr., *et al.*) 6 769

North Carolina
Stratigraphy
Paleocene, Lenoir County, Craven County
(Harris, W. B., *et al.*) 6 869

Northern Hemisphere
Stratigraphy
Mesozoic, Cenozoic, paleoclimatology
(Donn, W. L., *et al.*) 3 390

Northwest Territories
Structural geology
Tectonics, vertical tectonics, Arctic Archipelago, Sverdrup Basin
(Sweeney, J. F.) 1 41

Norway
Sedimentary petrology
Sedimentation, cyclic, Devonian, west, Hornelen Basin
(Steel, R. J., *et al.*) 8 1124

Ocean basins
Arctic Ocean
Barents Sea, evolution, structure, sedimentation, geophysical surveys
(Eldholm, O., *et al.*) 7 1015
Atlantic region
Atlantic Ocean, Norwegian Sea, Arctic Ocean, Greenland Sea, evolution, sea-floor spreading, mid-ocean ridges, fracture zones, magnetic anomalies, continental drift, reconstruction
(Talwani, M., *et al.*) 7 969

Ocean floors
Atlantic Ocean
Mid-Atlantic Ridge, FAMOUS, mid-ocean ridges, heat flow, crust, hydrothermal processes, sea-floor spreading, plate tectonics
(Williams, D. L., *et al.*) 4 531
Mid-Atlantic Ridge, FAMOUS, mid-ocean ridges, rift valleys, basalt, geochemistry, magma chambers, plate tectonics
(White, W. M., *et al.*) 4 571
Mid-Atlantic Ridge, FAMOUS, mid-ocean ridges, rift valleys, basalt, geochemistry, sulfide, globules
(Czamanske, G. K., *et al.*) 4 587
Mid-Atlantic Ridge, FAMOUS, mid-ocean ridges, rift valleys, exploration, submersibles, technology
(Ballard, R. D., *et al.*) 4 495
Mid-Atlantic Ridge, FAMOUS, mid-ocean ridges, rift valleys, median valleys, lava flows, basalt, petrography, composition
(Bryan, W. B., *et al.*) 4 556
Mid-Atlantic Ridge, FAMOUS, mid-ocean ridges, rift valleys, median valleys, morphology, topography, structure, sea-floor spreading, geophysical surveys, deep-tow
(Macdonald, K. C., *et al.*) 5 621
Mid-Atlantic Ridge, FAMOUS, mid-ocean ridges, rift valleys, median valleys, sea-floor spreading, crust, accretion, magnetic anomalies
(Macdonald, K. C.) 4 541
Mid-Atlantic Ridge, FAMOUS, mid-ocean ridges, rift valleys, morphology, topography, structure, geophysical surveys, deep-tow, sonar, side-scanning, photography, lava, pillow lava
(Luyendyk, B. P., *et al.*) 5 648
Mid-Atlantic Ridge, FAMOUS, mid-ocean ridges, rift valleys, observations, submersibles, programs
(Heirtzler, J. R., *et al.*) 4 481

Mid-Atlantic Ridge, FAMOUS, mid-ocean ridges, rift valleys, sea-floor spreading, evolution, axis, changes
(Ramberg, I. B., *et al.*) 5 609
Mid-Atlantic Ridge, FAMOUS, mid-ocean ridges, rift valleys, sea water, temperature, deep sea, applications, plate tectonics, hydrothermal processes, heat flow, possibilities
(Fehn, U., *et al.*) 4 488
Mid-Atlantic Ridge, FAMOUS, mid-ocean ridges, rift valleys, topography, bathymetry, tectonics, structure, faults, transform, plate tectonics
(Ramberg, I. B., *et al.*) 4 577
Mid-Atlantic Ridge, FAMOUS, mid-ocean ridges, topography, exploration, submersibles, tectonics, structure, rift valleys, evolution, igneous activity, volcanism
(Ballard, R. D., *et al.*) 4 507
Mid-Atlantic Ridge, FAMOUS, paleomagnetism, magnetic properties, sea-floor spreading
(Johnson, H. P., *et al.*) 5 637
Mid-Atlantic Ridge, FAMOUS, seismicity, earthquakes, detection, observations, seismographs
(Francis, T. J. G., *et al.*) 5 664
North Atlantic, Bahamas, Blake Plateau, bottom features, platforms, genesis, models, rifting, crust, continental genesis, Triassic
(Mullins, H. T., *et al.*) 10 1447
West, equatorial, Ceara Rise, bottom features, rises, aseismic, topography, structure, evolution, geophysical surveys, seismic surveys
(Kumar, N., *et al.*) 5 683

Indian Ocean
Africa, Southern Africa, Agulhas Plateau, Agulhas Basin, bottom features, topography, geophysical surveys, magnetic anomalies, plate tectonics
(Barrett, D. M.) 6 749
Agulhas Plateau, plateaus, sedimentation, geophysical surveys, cores
(Tucholke, B. E., *et al.*) 9 1337
Ninetyeast Ridge, aseismic ridges, evolution, models, plate tectonics
(Luyendyk, B. P., *et al.*) 9 1347

Mediterranean Sea
East, Crete, Pliny Trench, Strabo Trench, trenches, subduction, structure, geophysical surveys
(Jongsma, D.) 6 797

Pacific Ocean
East Pacific Rise, mid-ocean ridges, crests, seismic surveys, refraction, low-velocity zone, partial melting
(Reid, I., *et al.*) 5 678
Juan de Fuca Ridge, mid-ocean ridges, fracture zones, median valleys, sea-floor spreading, sedimentation, structure, seismic surveys, bathymetry
(Davis, E. E., *et al.*) 3 346
North Pacific, Meiji Tongue, bottom features, sedimentary rocks, sediments, tongues, plate tectonics, indicators
(Scholl, D. W., *et al.*) 11 1567
North Pacific, Nitinat Fan, submarine fans, sedimentation, Holocene
(Stokke, P. R., *et al.*) 11 1586

Oceanography

Instruments
Submersibles, Alvin, technology, systems, Atlantic Ocean, Mid-Atlantic Ridge, FAMOUS
(Ballard, R. D., *et al.*) 4 495

Research
Programs, submersibles, observations, mid-ocean ridges, rift valleys, Atlantic Ocean, Mid-Atlantic Ridge, FAMOUS
(Heirtzler, J. R., *et al.*) 4 481

Oklahoma

Sedimentary petrology
Sedimentary rocks, tuff, sedimentation, Mississippian, Ouachita Mountains
(Niem, A. R.) 1 49

Stratigraphy
Pennsylvanian, Morrowan, northeast
(Sutherland, P. K., *et al.*) 3 425

Oligocene

Europe
Mediterranean region, Sardinia, Corsica, Alps, paleogeography, continental drift
(Chabrier, G., *et al.*) 11 1694

Mexico
Sierra Madre Occidental, absolute age, volcanism
(McDowell, F. W., *et al.*) 10 1479

United States
Utah, northwest, tectonics, metamorphism, absolute age
(Compton, R. R., *et al.*) 9 1237
Washington, Tatoosh Intrusion, absolute age
(Mattinson, J. M.) 10 1509

Oman

Tectonophysics
Plate tectonics, obduction, Oman Mountains
(Gealey, W. K.) 8 1183
Plate tectonics, subduction, Oman Mountains
(Welland, M. J. P., *et al.*) 8 1081

Ordovician

United States
Vermont, New Hampshire, Connecticut Valley, metavolcanic rocks, geochemistry, plate tectonics, orogeny, middle Ordovician, Ammonoosuc Volcanics
(Aleinikoff, J. N.) 11 1546

Oregon

Sedimentary petrology
Sedimentary structures, interpretation, sedimentary rocks, conglomerate, turbidite, Jurassic, southwest, Coast Ranges
(Walker, R. G.) 2 273

Stratigraphy
Quaternary, Jefferson County, Deschutes County, Cascade Range, Metolius River region, Mount Jefferson, Three-Fingered Jack, Mount Washington
(Scott, W. E.) 1 113

Organic materials

Abundance
Sediments, sand, organic carbon, distribution, continental shelf, inner shelf, ecology, Invertebrata, Atlantic Ocean, United States, Georgia
(Pinet, P. R., *et al.*) 12 1731

Orogeny

Extent
Hercynian Orogeny, faults, wrench, fold belts, shear zones, plate tectonics, Paleozoic, Africa, North Africa, Europe
(Arthaud, F., *et al.*) 9 1305

Oxygen

Isotopes
O-18/O-16, fractionation, geologic thermometry, burial metamorphism, diagenesis, shale, analysis, data, Gulf Coastal Plain, Gulf of Mexico
(Yeh, H.-W., *et al.*) 9 1321

Pacific Ocean

Geochemistry
Metals, sediments, South Pacific, Nazca Plate, East Pacific Rise, Bauer Deep, Central Basin
(Heath, G. R., *et al.*) 5 723

Geochronology
Absolute age, Cenozoic, Nazca Plate, Bellingshausen abyssal plain, Deep Sea Drilling Project, Leg 34, Leg 35
(Seidemann, D. E.) 11 1660

Oceanography
Nodules, phosphate, South Pacific, South America, Chile, Peru
(Burnett, W. C.) 6 813
Sedimentation, ocean floors, North Pacific, Cascadia Basin, Nitinat Fan
(Stokke, P. R., *et al.*) 11 1586
Sedimentary petrology
Sediments, petrography, Miocene, North Pacific, Deep Sea Drilling Project, Site 32
(Vallier, T. L., *et al.*) 6 787
Seismology
Crust, East Pacific Rise
(Reid, I., *et al.*) 5 678
Stratigraphy
Pleistocene, Brunhes Epoch, paleoclimatology, biostratigraphy, foraminifera, west, equatorial
(Valencia, M. J.) 1 143
Tectonophysics
Plate tectonics, evolution, Galapagos Islands, Cocos Plate, Nazca Plate
(Hey, R.) 10 1404
Plate tectonics, indicators, North Pacific, Meiji Tongue, Deep Sea Drilling Project, Site 192
(Scholl, D. W., *et al.*) 11 1567
Plate tectonics, movement, Galapagos Islands, Cocos Plate, Nazca Plate
(Hey, R., *et al.*) 10 1385
Plate tectonics, sea-floor spreading, geophysical surveys, North Pacific, Juan de Fuca Ridge, Sovanco fracture zone
(Davis, E. E., *et al.*) 3 346

Pakistan
Structural geology
Tectonics, structure, Punjab, Salt Range, Potwar Plateau
(Farah, A., *et al.*) 8 1147

Paleocene
Europe
Italy, Gubbio, biostratigraphy, zoning, foraminifera, geochronology, paleomagnetism
(Premoli Silva, I.) 3 371
Italy, Gubbio, geochronology, paleomagnetism
(Roggenthen, W. M., *et al.*) 3 378
Italy, Gubbio, geochronology, time scales, paleomagnetism, type section
(Alvarez, W., *et al.*) 3 383
Italy, Gubbio, sedimentary rocks, lithostratigraphy, thickness, boundary, geochronology, paleomagnetism, Scaglia rossa
(Arthur, M. A., *et al.*) 3 367
United States
North Carolina, biostratigraphy, foraminifera, planktonic, absolute age, Beaufort Formation
(Harris, W. B., *et al.*) 6 869

Paleoclimatology
Evolution
Temperature, changes, models, Adem, paleogeography, continental drift, polar wandering, Mesozoic, Cenozoic, Northern Hemisphere
(Donn, W. L., *et al.*) 3 390
Holocene
United States, California, Santa Barbara Basin, patterns, temperature, precipitation, rain, sedimentary structures, laminations, varves, thickness, tree rings, growth rings, data, 19th century, 20th century
(Soutar, A., *et al.*) 8 1161
Pleistocene
Pacific Ocean, west, equatorial, Brunhes Epoch, cycles, indicators, foraminifera, planktonic, sediments, cores
(Valencia, M. J.) 1 143
United States, Delmarva Peninsula, upper Pleistocene, indicators, palynomorphs, pollen analysis, absolute age
(Sirkin, L. A., *et al.*) 1 139

Paleoecology
Invertebrata
Permian, marine, communities, mass extinction, salinity, global
(Stevens, C. H.) 1 133
Quaternary
United States, New Mexico, Chaco Canyon, sedimentation, terrestrial environment, rivers, archaeological sites, vegetation, pollen analysis
(Hall, S. A.) 11 1593

Paleogeography
Oligocene
Mediterranean region, Sardinia, Corsica, Alps, reconstruction
(Chabrier, G., *et al.*) 11 1694

Paleomagnetism
Cretaceous
Europe, Italy, Gubbio, reversals, geochronology, zoning
(Lowrie, W., *et al.*) 3 374
Experimental studies
Igneous rocks, basalt, magnetic properties, variations, sea-floor spreading, axis, distance, samples, dredged, Atlantic Ocean, Mid-Atlantic Ridge, FAMOUS
(Johnson, H. P., *et al.*) 5 637
Pole positions
Polar wandering, demagnetization, data, igneous rocks, plutonic rocks, alkalic composition, Precambrian, Paleozoic, Colorado
(French, R. B., *et al.*) 12 1785
Reversals
Geochronology, time scales, type section, Cretaceous, Paleocene, Italy, Gubbio
(Alvarez, W., *et al.*) 3 383
Geochronology, zoning, Cretaceous, Paleocene, Italy, Gubbio
(Roggenthen, W. M., *et al.*) 3 378
Tertiary
Atlantic Ocean, Iceland, west, Miocene, Pliocene, boundary, time scales, lava, basalt
(McDougall, I., *et al.*) 1 1

Paleozoic
Atlantic region
Atlantic Ocean, Iapetus, England, Lake District, plate tectonics, continental drift, paleogeography, orogeny, Caledonian, lower Paleozoic
(Moseley, F.) 6 764
Eastern Hemisphere
Europe, Africa, North Africa, tectonics, plate tectonics, Hercynian Orogeny, upper Paleozoic
(Arthaud, F., *et al.*) 9 1305
North America
North American Cordillera, stratigraphy, correlation, tectonics, igneous activity, geosynclines, plate tectonics
(Churkin, M., Jr., *et al.*) 6 769
South America
Andes, Western Cordillera, Peru, metamorphic rocks, absolute age, plate tectonics
(Cobbing, E. J., *et al.*) 2 241
United States
Appalachians, Piedmont, absolute age, metamorphic rocks, Glenarm Series
(Higgins, M. W., *et al.*) 1 125
California, Sierra Nevada, Mount Morrison, metamorphic rocks, metasedimentary, metavolcanic, stratigraphy, structural analysis, Ordovician, Silurian, Permian
(Russell, S., *et al.*) 3 335
California, Sierra Nevada, Saddlebag Lake, metamorphic rocks, metasedimentary, metavolcanic, stratigraphy, structural analysis, Ordovician, Silurian, Permian
(Brook, C. A.) 3 321
California, Sierra Nevada, sections, lithostratigraphy, thickness, petrology, upper Paleozoic, Silurian, Shoo Fly Formation, Devonian, Sierra Buttes Formation, Elwell Formation, Taylor Formation, Carboniferous, Mississippian, Peale Formation,

Permian, Goodhue Formation, Reeve Formation
(Durrell, C., *et al.*) 6 844
Colorado, paleomagnetism, lower Paleozoic
(French, R. B., *et al.*) 12 1785
Nevada, southeast, metamorphic rocks, stratigraphy, correlation, tectonics
(Burchfiel, B. C., *et al.*) 11 1623

Palynomorphs
Miospores
Pleistocene, Atlantic Coastal Plain, Delmarva Peninsula, pollen analysis, vegetation, paleoecology, paleoclimatology
(Sirkin, L. A., *et al.*) 1 139
Quaternary, New Mexico, Chaco Canyon, pollen analysis, biostratigraphy
(Hall, S. A.) 11 1593

Panama
Geochemistry
Major elements, trace elements, volcanic rocks, tholeiite, Cretaceous, Eocene
(Goossens, P. J., *et al.*) 12 1711

Pennsylvania
Geophysical surveys
Gravity surveys, southeast, Newark-Gettysburg Basin
(Sumner, J. R.) 7 935

Pennsylvanian
United States
Oklahoma, Arkansas, sedimentary rocks, carbonate rocks, biostratigraphy, lithostratigraphy, correlation, unconformities, paleoenvironment, stratigraphic units, nomenclature, new names, lower Pennsylvanian, middle Pennsylvanian, Morrowan, Bloyd Shale, Sausbee Formation, McCully Formation
(Sutherland, P. K., *et al.*) 3 425

Permian
Paleontology
Invertebrata, foraminifera, paleoecology, extinction, paleooceanography, salinity, sedimentary rocks, halite
(Stevens, C. H.) 1 133

Peru
Geochronology
Absolute age, dates, Precambrian, Paleozoic, south, Andes, Western Cordillera
(Cobbing, E. J., *et al.*) 2 241
Structural geology
Tectonics, structure, north
(Hollister, V. F.) 12 1749

Phanerozoic
Atlantic region
North America, Europe, North Africa, Invertebrata, biogeography, plate tectonics, continental drift, orogeny, Paleozoic, Mesozoic, Cenozoic
(Fallaw, W. C.) 1 62

Planetology
Techniques
Planets, surface materials, relative age, craters, morphology, distribution
(McGill, G. E.) 8 1102

Plate tectonics
Age
Jurassic, Cretaceous, Tertiary, movement, rates, sea-floor spreading, continental drift, models, igneous rocks, alkalic, volcanic, absolute age, whole rock, South Atlantic, South American Plate
(Herz, N.) 1 101
Tertiary, movement, subduction, triple junctions, igneous activity, volcanism, metallogeny, Nevada, Utah
(Stewart, J. H., *et al.*) 1 67
Europe
England, Lake District, reconstruction, paleogeography, orogeny, evolution, Paleozoic, Caledonian
(Moseley, F.) 6 764

Evolution
Ocean basins, sea-floor spreading, mid-ocean ridges, fracture zones, magnetic anomalies, continental drift, reconstruction, Atlantic Ocean, Norwegian Sea, Arctic Ocean, Greenland Sea
(Talwani, M., *et al.*) 7 969
Ridges, aseismic ridges, models, hot spots, plates, movement, continental drift, paleomagnetism, reconstruction, models, Cretaceous, Cenozoic, Indian Ocean, Ninetyeast Ridge
(Luyendyk, B. P., *et al.*) 9 1347
Spreading centers, hot spots, accretion, asymmetry, models, magnetic anomalies, bathymetry, Cenozoic, Pacific Ocean, Galapagos Islands, Cocos Plate, Nazca Plate
(Hey, R.) 10 1404
Geometry
Plates, accretion, ridges, oceanic, models, steady-state, constraints, complexes, ophiolite, layered, cumulates, convection, cooling, magma chambers, partial melting, Newfoundland, west
(Dewey, J. F., *et al.*) 7 960
Sea-floor spreading, axis, orientation, changes, rotation, fracture zones, faults, magnetic anomalies, evolution, Quaternary, Atlantic Ocean, Mid-Atlantic Ridge, FAMOUS
(Ramberg, I. B., *et al.*) 5 609
Triple junctions, extinct, geophysical surveys, magnetic anomalies, fracture zones, sea-floor spreading, rates, plates, movement, evolution, continental drift, Tertiary, Arctic region, Greenland, North America, Atlantic Ocean, North Atlantic
(Kristoffersen, Y., *et al.*) 7 1037
Triple junctions, microplates, rotation, evolution, faults, transform faults, spreading centers, rates, models, volcanism, Cenozoic, Ethiopia, Afars and Issas Territory, Afar
(Barberi, F., *et al.*) 9 1251
Indicators
Sedimentation, tongues, sedimentary rocks, sediments, thickness, clay mineralogy, plates, movement, subduction, Cenozoic, Pacific Ocean, North Pacific, Meiji Tongue, Pacific Plate, North American Plate
(Scholl, D. W., *et al.*) 11 1567
Melanesia
Solomon Islands, Malaita, evolution, subduction, trenches, island arcs, sedimentation, crust, oceanic, Cenozoic
(Hughes, G. W., *et al.*) 3 412
Middle East
Turkey, Antalya, ophiolite, complexes, tectonite, structural analysis, models, ridges, crust, oceanic type
(Juteau, T., *et al.*) 12 1740
Movement
Accretion, asymmetry, spreading centers, magnetic anomalies, models, Quaternary, Pacific Ocean, Galapagos Islands, Cocos Plate, Nazca Plate
(Hey, R., *et al.*) 10 1385
Shear zones, fold belts, faults, strike-slip faults, Hercynian Orogeny, Paleozoic, Africa, North Africa, Europe
(Arthaud, F., *et al.*) 9 1305
North America
North American Cordillera, terranes, basement, stratigraphy, correlation, Precambrian, Paleozoic
(Churkin, M., Jr., *et al.*) 6 769
Obduction
Ophiolite, complexes, emplacement, slabs, collision, continental margin, models, Cretaceous, Arabian Peninsula, Oman, Oman Mountains
(Gealey, W. K.) 8 1183
Processes
Sea-floor spreading, asymmetric, oblique, crust, accretion, magnetic anomalies, Atlantic Ocean, Mid-Atlantic Ridge, FAMOUS
(Macdonald, K. C.) 4 541
Sedimentation, rifting, spreading centers, median valleys, crust, accretion, mechanism, models, seismic surveys, reflection, Pacific Ocean, Juan de Fuca Ridge, Sovanco fracture zone
(Davis, E. E., *et al.*) 3 346

Rifting
Observations, programs, submersibles, Atlantic Ocean, Mid-Atlantic Ridge, FAMOUS
(Heirtzler, J. R., *et al.*) 4 481
Platforms, genesis, crust, continental genesis, models, Triassic, Atlantic Ocean, Bahamas, Blake Plateau
(Mullins, H. T., *et al.*) 10 1447
Structure
Boundary, crust, upper mantle, velocity structure, P-waves, anomalies, California, Transverse Ranges
(Hadley, D., *et al.*) 10 1469
Crust, oceanic, experimental studies, laboratory studies, basalt, tholeiite, serpentinite, density, P-waves, velocity, Atlantic Ocean, Mid-Atlantic Ridge, FAMOUS
(Schreiber, E., *et al.*) 4 600
Faults, transform, rift valleys, Atlantic Ocean, Mid-Atlantic Ridge, FAMOUS
(Ramberg, I. B., *et al.*) 4 577
Mid-ocean ridges, rift valleys, geophysical surveys, deep-tow, sonar, side-scanning, bathymetry, photography, Atlantic Ocean, Mid-Atlantic Ridge, FAMOUS
(Luyendyk, B. P., *et al.*) 5 648
Subduction
Ophiolite, complexes, emplacement, accretion, collision, continental margin, models, faults, Cretaceous, Arabian Peninsula, Oman, Oman Mountains, Iran, Zagros
(Welland, M. J. P., *et al.*) 8 1081
Rates, trenches, structure, geophysical surveys, Mediterranean Sea, Crete, Pliny Trench, Strabo Trench
(Jongsma, D.) 6 797
Rates, variations, magmas, genesis, volcanism, interpretation, Pacific region, Aleutian Islands
(Price, C., *et al.*) 3 462

Pleistocene
Canada
Saskatchewan, sedimentary structures, Floral Formation
(Hendry, H. E., *et al.*) 6 809
Pacific Ocean
West, equatorial, paleoclimatology, foraminifera, upper Pleistocene, Brunhes Epoch
(Valencia, M. J.) 1 143
United States
Atlantic Coastal Plain, Delmarva Peninsula, paleoclimatology, paleoenvironment, absolute age, palynomorphs, upper Pleistocene, Parsonsburg Sand
(Sirkin, L. A., *et al.*) 1 139
California, San Diego, paleoenvironment, paleogeography, changes of level, biostratigraphy, Mollusca, terraces, upper Pleistocene
(Kern, J. P.) 11 1553
Maine, west-central, glaciation, till, stratigraphy, correlation, upper Pleistocene, Wisconsinan
(Borns, H. W., Jr., *et al.*) 12 1773
New England, Connecticut, deglaciation, Wisconsinan
(Black, R. F.) 9 1331
New York, Albany, sedimentation, upper Pleistocene, Wisconsinan
(Donahue, J. J.) 12 1756
New York, Mohawk Valley, deglaciation, upper Pleistocene, Wisconsinan
(Krall, D. B.) 12 1697

Pliocene
Atlantic Ocean
Iceland, west, stratigraphy, correlation, geochronology, time scales, paleomagnetism, absolute age, boundary, lower Pliocene
(McDougall, I., *et al.*) 1 1

Precambrian
Asia
India, diagenesis, Bhander Limestone
(Chanda, S. K., *et al.*) 11 1577
Canada
Quebec, Grenville Province, absolute age
(Doig, R.) 12 1843
Europe
Scotland, west, metamorphism, syntectonic, diachronism, upper Precambrian, Moinian
(MacQueen, J. A., *et al.*) 2 235
South America
Andes, Western Cordillera, Peru, metamorphic rocks, absolute age
(Cobbing, E. J., *et al.*) 2 241
United States
Colorado, Mosquito Range, Treasurevault Stock, petrology
(Kuntz, M. A., *et al.*) 3 465
Colorado, paleomagnetism, upper Precambrian
(French, R. B., *et al.*) 12 1785
Michigan, north, paleosols
(Lewan, M. D., *et al.*) 9 1375
Utah, northwest, absolute age
(Compton, R. R., *et al.*) 9 1237
Wyoming, Bighorn Mountains, basement, absolute age
(Stueber, A. M., *et al.*) 3 441
Wyoming, Sierra Madre, absolute age, lower Precambrian, Archean, upper Precambrian
(Divis, A. F.) 1 96

Quaternary
Atlantic Ocean
North Atlantic, sedimentation, ice-rafting, upper Quaternary
(Ruddiman, W. F.) 12 1813
West, equatorial, sedimentation, lithostratigraphy, biostratigraphy, zoning, foraminifera, upper Quaternary
(Damuth, J. E.) 5 695
Canada
Maritime Provinces, continental margin, sedimentation, clay mineralogy, upper Quaternary
(Piper, D. J. W., *et al.*) 2 267
Newfoundland, Grand Banks, glaciation, deposition, deglaciation, sedimentation, changes of level, Pleistocene, Wisconsinan, Holocene
(Slatt, R. M.) 9 1357
United States
Hawaii, Lanai, volcanism, lava, absolute age
(Bonhommet, N., *et al.*) 9 1282
New Mexico, Chaco Canyon, biostratigraphy, palynomorphs, miospores, absolute age, paleoclimatology, paleoecology, archaeology, upper Quaternary
(Hall, S. A.) 11 1593
New York, Long Island, Brooklyn, sediments, clay, marine, age, biostratigraphy, Invertebrata, Pleistocene, Holocene
(Blank, H. R., *et al.*) 1 159
Oregon, Cascade Range, Metolius River region, stratigraphy, till, drift, glaciation, volcanism, Abbott Butte Formation, Jack Creek Formation, Suttle Lake Member
(Scott, W. E.) 1 113

Quebec
Geochronology
Absolute age, Precambrian, northwest, Grenville Province, La Verendrye Park
(Doig, R.) 12 1843

Rhode Island
Geophysical surveys
Radioactivity methods, Kent County, Washington County
(Goldsmith, R., *et al.*) 7 925

Sardinia
Petrology
Inclusions, xenoliths, Pliocene, Quaternary, northwest, Pozzomaggiore
(de Albuquerque, C. A. R., *et al.*) 10 1493

Saskatchewan
Sedimentary petrology
Sedimentary structures, soft sediment deformation, Pleistocene, Saskatchewan
(Hendry, H. E., *et al.*) 6 809
Saudi Arabia
Petrology
Igneous rocks, granite, metamorphic rocks, west, Taif
(Nasseef, A. O., *et al.*) 12 1721
Scotland
Petrology
Metamorphic rocks, metasedimentary, metamorphism, Precambrian, Moinian, west, Caledonian Belt
(MacQueen, J. A., *et al.*) 2 235
Sea-floor spreading
Atlantic Ocean
Mid-Atlantic Ridge, FAMOUS, asymmetric, oblique, crust, accretion, magnetic anomalies, magnetic surveys, deep-tow
(Macdonald, K. C.) 4 541
Mid-Atlantic Ridge, FAMOUS, axis, orientation, changes, evolution, asymmetric, continuous
(Ramberg, I. B., *et al.*) 5 609
Mid-Atlantic Ridge, FAMOUS, magnetic anomalies, interpretation, experimental studies, basalt, dredged, magnetic properties, variations, axis, distance
(Johnson, H. P., *et al.*) 5 637
Atlantic region
Atlantic Ocean, Norwegian Sea, Arctic Ocean, Greenland Sea, ocean basins, evolution
(Talwani, M., *et al.*) 7 969
Pacific Ocean
Juan de Fuca Ridge, rates, spreading centers, median valleys, seismic surveys, reflection
(Davis, E. E., *et al.*) 3 346
Sea water
Experimental studies
Temperature, distribution, deep water, measurement, data, possibilities, hydrothermal processes, heat flow, plate tectonics, Atlantic Ocean, Mid-Atlantic Ridge, FAMOUS
(Fehn, U., *et al.*) 4 488
Sedimentary rocks
Carbonate rocks
Limestone, lithostratigraphy, biostratigraphy, host rocks, ore deposits, lead, silver, Cretaceous, Mexico
(Lozej, G. P., *et al.*) 12 1793
Lithofacies, environmental analysis, lithostratigraphy, biostratigraphy, Pennsylvanian, Morrowan, Oklahoma, Arkansas
(Sutherland, P. K., *et al.*) 3 425
Oomicrite, petrography, textures, oolitic texture, allochems, ooids, nodules, chert, diagenesis, compaction, cementation, Precambrian, Bhander Limestone, India
(Chanda, S. K., *et al.*) 11 1577
Chemically precipitated rocks
Halite, occurrence, volume, Invertebrata, mass extinction, Permian, global
(Stevens, C. H.) 1 133
Phosphorite, genesis, experimental studies, nodules, phosphate, continental margin, Pacific Ocean, Chile, Peru
(Burnett, W. C.) 6 813
Clastic rocks, terrigenous
Conglomerate, turbidite, textures, fabric, sedimentary structures, graded bedding, environmental analysis, sedimentation, paleocurrents, Jurassic, Oregon, southwest
(Walker, R. G.) 2 273
Lithofacies, environmental analysis, marine, shallow water, sedimentary structures, Cretaceous, Frontier Formation, Utah
(Ryer, T. A.) 2 177
Sandstone, conglomerate, environmental analysis, textures, grain size, paleocurrents, directions, provenance, sedimentary structures, Silurian, Tuscarora Sandstone, Virginia, west
(Whisonant, R. C.) 2 215
Sandstone, lithofacies, environmental analysis, intertidal, sedimentary structures, cross-stratification, ichnofossils, Cambrian, Tapeats Sandstone, Arizona
(Hereford, R.) 2 199
Saprolite, iron, estimation, visual, weathering, Georgia
(Hurst, V. J.) 2 174
Shale, diagenesis, burial metamorphism, geologic thermometry, isotopes, oxygen, ratios, United States, Gulf Coastal Plain, Gulf of Mexico
(Yeh, H.-W., *et al.*) 9 1321
Tuff, sedimentary structures, channels, U-shaped, erosion, base surges, Quaternary, Hawaii, Oahu, Koko Crater
(Fisher, R. V.) 9 1287
Tuff, vitric tuff, petrography, grain size, thickness, provenance, transport, paleocurrents, lithostratigraphy, Mississippian, Oklahoma, Arkansas, Ouachita Mountains
(Niem, A. R.) 1 49
Sedimentary structures
Bedding plane irregularities
Ripple marks, orientation, theoretical studies, movement, initiation, slopes, wind transport
(Howard, A. D.) 6 853
Environmental analysis
Bedding, cross-bedding, cross-stratification, ichnofossils, sandstone, lithofacies, Cambrian, Tapeats Sandstone, Arizona
(Hereford, R.) 2 199
Interpretation
Graded bedding, imbrication, environmental analysis, submarine fans, paleocurrents, turbidity currents, conglomerate, turbidite, Jurassic, Oregon, southwest
(Walker, R. G.) 2 273
Planar bedding structures
Channels, U-shaped, erosion, base surges, Hawaii, Oahu, Koko Crater
(Fisher, R. V.) 9 1287
Cross-bedding, environmental analysis, paleocurrents, directions, sandstone, grain size, Silurian, Tuscarora Sandstone, Virginia, west
(Whisonant, R. C.) 2 215
Laminations, varves, thickness, environmental analysis, climate, rain, temperature, 19th century, 20th century, Pacific Ocean, California, Santa Barbara Basin
(Soutar, A., *et al.*) 8 1161
Soft sediment deformation
Folds, recumbent, cross-bedding, facing, criteria, inversion, kinematics, geometry, Pleistocene, Floral Formation, Saskatchewan
(Hendry, H. E., *et al.*) 6 809
Sedimentation
Controls
Structural controls, tectonics, subsidence, sedimentary basins, rates, upper Paleozoic, Mesozoic, Northwest Territories, Sverdrup Basin
(Sweeney, J. F.) 1 41
Structural controls, tectonics, uplifts, marine environment, paleogeography, ophiolite, emplacement, models, Tertiary, Cyprus, Troodos Massif
(Robertson, A. H. F.) 12 1763
Cyclic
Alluvial fans, rivers, braided streams, sedimentary structures, structural controls, faults, Devonian, Europe, Norway, west, Hornelen Basin
(Steel, R. J., *et al.*) 8 1124
Lithofacies, models, transgression, disconformities, environment, marine, shallow water, Cretaceous, Frontier Formation, United States, Western Interior, Utah
(Ryer, T. A.) 2 177
Deposition
Continental margin, abyssal plains, cyclic, controls, paleoclimatology, rates, marine transport, provenance,

Quaternary, Atlantic Ocean, west, equatorial
(Damuth, J. E.) 5 695

Diagenesis
Compaction, cementation, deformation, ooids, nodules, chert, oomicrite, Precambrian, Bhander Limestone, India
(Chanda, S. K., *et al.*) 11 1577

Environment
Tidal, intertidal, cyclic, sandstone, lithofacies, sedimentary structures, Cambrian, Tapeats Sandstone, Arizona
(Hereford, R.) 2 199

Provenance
Interpretation, paleocurrents, transport, volcanism, eruptions, plate tectonics, Mississippian, Oklahoma, Arkansas, Ouachita Mountains
(Niem, A. R.) 1 49
Paleocurrents, directions, grain size, cross-bedding, sandstone, Silurian, Tuscarora Sandstone, Virginia, west
(Whisonant, R. C.) 2 215

Rates
Sedimentary rocks, sediments, thickness, plate tectonics, indicators, Cenozoic, Pacific Ocean, North Pacific, Meiji Tongue
(Scholl, D. W., *et al.*) 11 1567
Shale, limestone, thickness, bioturbation, oxidation, geochronology, paleomagnetism, Cretaceous, Paleocene, Italy, Gubbio
(Arthur, M. A., *et al.*) 3 367

Transport
Ice-rafting, deposition, rates, patterns, changes, glacial environment, interglacial environment, paleo-oceanography, circulation, data, cores, sediments, sand, Quaternary, Atlantic Ocean, North Atlantic
(Ruddiman, W. F.) 12 1813
Marine transport, currents, bottom currents, photographs, cores, sediments, deposition, distribution, isopach maps, seismic surveys, cores, unconformities, Cenozoic, Indian Ocean, Agulhas Plateau
(Tucholke, B. E., *et al.*) 9 1337
Marine transport, flow regime, provenance, changes of level, sediments, lithofacies, Quaternary, Newfoundland, Grand Banks
(Slatt, R. M.) 9 1357
Marine transport, patterns, continental shelf, bottom features, Holocene, modern, North Carolina, Diamond Shoals
(Hunt, R. E., *et al.*) 2 299
Marine transport, turbidity currents, continental margin, cores, clay mineralogy, provenance, Canada, North Atlantic
(Piper, D. J. W., *et al.*) 2 267
Marine transport, turbidity currents, suspended materials, nepheloid layer, submarine fans, clay, dispersion, deposition, rates, thickness, Holocene, Pacific Ocean, Nitinat Fan
(Stokke, P. R., *et al.*) 11 1586
Stream transport, channels, response, catastrophic, observations, concepts, Wolman, Miller, floods, magnitude, frequency, Texas, central
(Baker, V. R.) 8 1057
Stream transport, marine transport, patterns, deposition, rivers, mouths, deltas, theoretical studies, engineering geology
(Wright, L. D.) 6 857
Stream transport, metals, transition metals, Brazil, Amazon River, Alaska, Yukon River
(Gibbs, R. J.) 6 829
Stream transport, pebbles, monitoring, techniques, floods, Wyoming, west, Horse Creek
(Butler, P. R.) 8 1072
Wind transport, dunes, orientation, patterns, topography, controls, sand, granulometry, Pleistocene, Wisconsinan, New York, Albany
(Donahue, J. J.) 12 1756
Wind transport, theoretical studies, movement, initiation, slopes, ripple marks, orientation
(Howard, A. D.) 6 853

Sediments

Clastic sediments, terrigenous
Clay, marine, age, interpretation, Quaternary, New York, Brooklyn
(Blank, H. R., *et al.*) 1 159
Clay, textures, grain size, data, cores, statistical analysis, deposition, dispersion, submarine fans, Holocene, Pacific Ocean, Nitinat Fan
(Stokke, P. R., *et al.*) 11 1586
Drift, textures, grain size, statistical analysis, environmental analysis, glaciers, alpine, Quaternary, Washington, Nisqually Glacier, Paradise Glacier, South Cascade Glacier, Alberta, Athabasca Glacier
(Mills, H. H.) 8 1135
Sand, geochemistry, organic carbon, distribution, grain size, depth, continental shelf, inner shelf, Georgia, Doboy Sound, Altamaha Sound
(Pinet, P. R., *et al.*) 12 1731
Sand, grain size, dunes, Pleistocene, Wisconsinan, New York, Albany
(Donahue, J. J.) 12 1756
Till, basal till, textures, fabric, clasts, size, shape, orientation, data, glaciers, alpine, Holocene, modern, Washington, Alberta
(Mills, H. H.) 6 824
Till, drift, lithostratigraphy, Quaternary, Oregon, Cascade Range, Metolius River region
(Scott, W. E.) 1 113
Till, fabric, moraines, deglaciation, Pleistocene, Wisconsinan, New York, Mohawk Valley
(Krall, D. B.) 12 1697
Till, textures, lithostratigraphy, Pleistocene, Maine, west-central
(Borns, H. W., Jr., *et al.*) 12 1773

Composition
Chemical composition, metalliferous, data, provenance, genesis, transformations, Holocene, modern, Pacific Ocean, southeast
(Heath, G. R., *et al.*) 5 723
Mineral composition, clay minerals, continental margin, provenance, Quaternary, Canada, Maritime Provinces
(Piper, D. J. W., *et al.*) 2 267

Distribution
Continental margin, abyssal plains, classification, pelagic, hemipelagic, reworking, deposition, cyclic, provenance, lithostratigraphy, biostratigraphy, Quaternary, Atlantic Ocean, west, equatorial
(Damuth, J. E.) 5 695

Lithofacies
Carbonate sediments, terrigenous materials, sand, gravel, textures, grain size, provenance, Quaternary, Atlantic Ocean, Grand Banks
(Slatt, R. M.) 9 1357

Petrography
Pelagic sediments, particles, glass, basalt, microlapilli, size, geochemistry, major elements, data, genesis, volcanism, subaerial, Miocene, Pacific Ocean, northeast
(Vallier, T. L., *et al.*) 6 787

Properties
Acoustical properties, continental margin, data, sonobuoys, statistical analysis, Atlantic Ocean, South America
(Houtz, R. E.) 5 720

Seismology

Crust
Mid-ocean ridges, velocity structure, inhomogeneity, microearthquakes, low-velocity zone, partial melting, profiles, refraction, Pacific Ocean, East Pacific Rise
(Reid, I., *et al.*) 5 678

Earthquakes
Patterns, characterization, discrimination, algorithms, automatic data processing, prediction, California, Nevada
(Briggs, P., *et al.*) 2 161

Elastic waves
P-waves, velocity, experimental studies, laboratory studies, igneous rocks, metamorphic rocks, crust, oceanic, structure, Atlantic

Ocean, Mid-Atlantic Ridge, FAMOUS
(Schreiber, E., *et al.*) 4 600

Interior

Crust, upper mantle, structure, elastic waves, P-waves, traveltime, velocity, anomalies, plate tectonics, boundary, California, Transverse Ranges
(Hadley, D., *et al.*) 10 1469

Seismicity

Earthquakes, shallow focus, magnitude, occurrence, fault zones, neotectonics, plate tectonics, Quaternary, Central America
(Carr, M. J., *et al.*) 1 151

Mid-ocean ridges, earthquakes, detection, seismographs, ocean floors, Atlantic Ocean, Mid-Atlantic Ridge, FAMOUS
(Francis, T. J. G., *et al.*) 5 664

Silurian

United States

Nevada, California, Great Basin, biostratigraphy, zoning, Coelenterata, Anthozoa
(Johnson, J. G., *et al.*) 10 1462

Virginia, west, sedimentation, paleoenvironment, lower Silurian, Tuscarora Sandstone, Clinch Sandstone
(Whisonant, R. C.) 2 215

Silver

Mexico

Coahuila, ore deposits, mineralization, structural controls, host rocks, limestone, structure, stratigraphy, Cretaceous
(Lozej, G. P., *et al.*) 12 1793

Soils

Soil group

Paleosols, weathering, interpretation, Precambrian, Michigan, north
(Lewan, M. D., *et al.*) 9 1375

Solomon Islands

Areal geology

Petrology, stratigraphy, tectonophysics, Malaita
(Hughes, G. W., *et al.*) 3 412

South Africa

Geophysical surveys

Seismic surveys, offshore, Agulhas Plateau, Agulhas Basin
(Barrett, D. M.) 6 749

South Australia

Structural geology

Foliation, style, structural analysis, Macclesfield
(Marlow, P. C., *et al.*) 6 873

Structural analysis

Foliation

Cleavage, slip cleavage, axial-plane, layered, microstructure, mechanism, metamorphic rocks, metasedimentary, mica schist, Cambrian, Kanmantoo Group, South Australia, Macclesfield
(Marlow, P. C., *et al.*) 6 873

Interpretation

Deformation, strain, orientation, paths, folds, asymmetric, foliation, slaty cleavage, field studies, theoretical studies, models, computers, carbonate rocks, limestone, dolostone, Cambrian, Conococheague Formation, Appalachians, Blue Ridge, Virginia
(Wickham, J., *et al.*) 7 920

Faults, overthrust faults, folds, overturned folds, allochthons, autochthons, high-grade metamorphism, Utah, northwest
(Compton, R. R., *et al.*) 9 1237

Folds, foliation, axial-plane, lineation, faults, preferred orientation, interference patterns, chronology, metamorphic rocks, pendants, roof pendants, Paleozoic, Triassic, California, Sierra Nevada, Saddlebag Lake
(Brook, C. A.) 3 321

Folds, isoclinal, fold axes, faults, reverse, schistosity, lineation, interference patterns, chronology, metamorphic rocks, pendants, roof pendants, Paleozoic, Mesozoic, California, Sierra Nevada, Mount Morrison
(Russell, S., *et al.*) 3 335

Foliation, folds, fold axes, strain, faults, systems, evolution, Alaska, Denali Fault
(Hickman, R. G., *et al.*) 9 1217

Foliation, lineation, metamorphic rocks, pendants, shear zones, metamorphism, tectonics, evolution, orogeny, Nevadan Orogeny, Cretaceous, United States, California, Sierra Nevada, Oakhurst
(Russell, L. R., *et al.*) 10 1530

Foliation, lineation, schistosity, cumulates, igneous rocks, ophiolite, complexes, tectonite, models, plate tectonics, ridges, crust, oceanic type, Turkey, Antalya
(Juteau, T., *et al.*) 12 1740

Lineation, cleavage, schistosity, folds, nappes, interference patterns, metamorphism, polymetamorphism, metamorphic rocks, schist, Silurian, Devonian, Gile Mountain Formation, Waits River Formation, United States, Vermont, central
(Woodland, B. G.) 8 1111

Petrofabrics, garnet, zoning, metamorphism, syntectonic, diachronism, metamorphic rocks, metasedimentary, Precambrian, Moinian, Scotland, west, Caledonian Belt
(MacQueen, J. A., *et al.*) 2 235

Methods

Orientation tensors, eigenvalues, fabric, shape, indicators, deformation, strain, applications, structural geology, paleomagnetism, sedimentary petrology, glacial geology
(Woodcock, N. H.) 9 1231

Statistical methods, transition analysis, examples, Europe, Western Europe, Italy, Wales, Scotland, Middle East, Cyprus
(Naylor, M. A., *et al.*) 10 1488

Preferred orientation

Minerals, grains, displacements, kinematics, models, fabric, theoretical studies, experimental studies
(Willis, D. G.) 6 883

Theoretical studies

Folds, lineation, boudinage, mullions, genesis, mechanism, materials, non-Newtonian
(Smith, R. B.) 2 312

Sulfur

Geochemistry

Igneous rocks, basalt, glass, globules, sulfide, phase equilibria, rift valleys, Atlantic Ocean, Mid-Atlantic Ridge, FAMOUS
(Czamanske, G. K., *et al.*) 4 587

Tectonics

Asia

Iran, Zagros, Oman, Oman Mountains, ophiolite, complexes, emplacement, faults, block, thrust, models
(Welland, M. J. P., *et al.*) 8 1081

Evolution

Faults, strike-slip faults, wrench faults, shear zones, fold belts, plate tectonics, movement, models, Hercynian Orogeny, Paleozoic, Africa, North Africa, Europe
(Arthaud, F., *et al.*) 9 1305

Faults, systems, Phanerozoic, Alaska, Denali Fault
(Hickman, R. G., *et al.*) 9 1217

Structure

Basin range, faults, normal, mechanism, models, plate tectonics, extension, crust, continental, thinning, evolution, Cenozoic, United States, Nevada
(Proffett, J. M., Jr.) 2 247

Basins, faults, gravity surveys, profiles, Bouguer anomalies, maps, Triassic, Pennsylvania, Newark-Gettysburg Basin
(Sumner, J. R.) 7 935

Faults, thrust, grabens, areal geology, aerial photography, Mexico, Sonora, coastal
(Gastil, R. G., *et al.*) 2 189

Faults, thrust plates, ophiolite, emplacement, metamorphic rocks, complexes, Paleozoic, Triassic, California, Klamath Mountains, Preston Peak
(Snoke, A. W.) 11 1641

Folds, fold belts, fold axes, orientation, anomalies, faults, transcurrent faults, evolution, Andean Orogeny, Tertiary, Peru
(Hollister, V. F.) 12 1749

Folds, large-scale, recumbent, nappes, interpretation, United States, Appalachians, Valley and Ridge Province, Alabama
(Roeder, D., *et al.*) 1 157

Folds, structural analysis, interference patterns, United States, Appalachians, Blue Ridge Province, Toxaway Dome
(Hatcher, R. D., Jr.) 11 1678
Intrusions, batholiths, Bouguer anomalies, magnetic anomalies, profiles, seismic surveys, mapping, United States, California, Sierra Nevada Batholith
(Oliver, H. W.) 3 445
Mobile belts, transverse structures, patterns, evolution, neotectonics, USSR, Siberia, Koryak Range
(Raskatov, G. I., *et al.*) 2 221
Oroclines, fold belts, orientation, faults, thrust faults, crust, compression, Cretaceous, Tertiary, North America, United States, Alaska, Eurasia, USSR, Siberia, Bering Strait
(Patton, W. W., Jr., *et al.*) 9 1298
Patterns, igneous rocks, ore deposits, magnetic anomalies, airborne, plate tectonics, volcanism, Tertiary, Nevada, Utah
(Stewart, J. H., *et al.*) 1 67
Shields, basement, faults, block, sedimentary cover, Bouguer anomalies, maps, Asia, Pakistan, Punjab
(Farah, A., *et al.*) 8 1147

United States

Appalachians, Valley and Ridge Province, Alabama, Harpersville, Kelley Mountain, structural complexes, folds, recumbent folds, nappes, interpretation
(Thomas, W. A., *et al.*) 9 1368
Arizona, southeast, structural complexes, evolution, interpretation, gravity sliding, folds, uplifts, faults, thrust, domes, metamorphic rocks, gneiss, age
(Thorman, C. H., *et al.*) 8 1211
California, Mojave Desert, Old Dad Mountain, structural complexes, evolution, areal geology, shear zones, faults, thrust, normal, orogenic belts, Mesozoic, Tertiary
(Dunne, G. C.) 6 737
Nevada, New York Mountains, structural complexes, faults, strike-slip faults, allochthons, thrust plates, stratigraphy, Paleozoic, Mesozoic
(Burchfiel, B. C., *et al.*) 11 1623

Vertical tectonics

Neotectonics, active faults, Holocene, Arizona, Grand Canyon, Toroweap Fault, Hurricane Fault
(Huntoon, P. W.) 11 1619
Subsidence, rates, sedimentary basins, models, lithosphere, loading, plate tectonics, rifting, sea-floor spreading, evolution, upper Paleozoic, Mesozoic, Canada, Northwest Territories, Sverdrup Basin
(Sweeney, J. F.) 1 41
Uplifts, sedimentation, controls, ophiolite, emplacement, crust, oceanic type, plate tectonics, Tertiary, Cyprus, Troodos Massif
(Robertson, A. H. F.) 12 1763

Tectonophysics

Observations

Mid-ocean ridges, rift valleys, plate tectonics, sea-floor spreading, projects, Atlantic Ocean, Mid-Atlantic Ridge, FAMOUS
(Heirtzler, J. R., *et al.*) 4 481

Tertiary

Asia

India, Girnar, igneous rocks, complexes, absolute age, lower Tertiary, Paleogene
(Paul, D. K., *et al.*) 2 227

Middle East

Cyprus, Troodos Massif, sedimentation, tectonics
(Robertson, A. H. F.) 12 1763

South America

Brazil, absolute age, igneous rocks, alkalic, plate tectonics, continental drift
(Herz, N.) 1 101
Brazil, northeast, igneous rocks, volcanic, xenoliths
(Sial, A. N.) 8 1173
Peru, tectonics, orogeny, Andean Orogeny, lower Tertiary
(Hollister, V. F.) 12 1749

United States

Nevada, Utah, igneous activity, volcanism, metallogeny, plate tectonics
(Stewart, J. H., *et al.*) 1 67
Texas, New Mexico, Trans-Pecos magmatic province, Diablo Platform, plutonic rocks, petrology, absolute age, lower Tertiary
(Barker, D. S., *et al.*) 10 1437

Texas

Hydrogeology

Hydrology, rivers and streams, central, Edwards Plateau
(Baker, V. R.) 8 1057

Petrology

Igneous rocks, alkalic composition, magmas, Cenozoic, Trans-Pecos
(Barker, D. S.) 10 1421
Igneous rocks, composition, intrusions, Cenozoic, Trans-Pecos, Hudspeth County, Diablo Platform
(Barker, D. S., *et al.*) 10 1428
Igneous rocks, nepheline pyroxenite, nepheline syenite, magmas, genesis, southwest, Brewster County, Big Bend region, Christmas Mountains
(Joesten, R.) 10 1515
Igneous rocks, plutonic rocks, intrusions, magmas, Tertiary, Trans-Pecos, Hudspeth County, Diablo Platform
(Barker, D. S., *et al.*) 10 1437

Triassic

Atlantic Ocean

North Atlantic, Bahamas, Blake Plateau, plate tectonics, rifting, upper Triassic
(Mullins, H. T., *et al.*) 10 1447

Turkey

Structural geology

Structural analysis, interpretation, Antalya
(Juteau, T., *et al.*) 12 1740

United States

General

Geology, education
(Johnson, M. E.) 8 1192

Geochronology

Absolute age, dates, Mesozoic, Oregon, Washington, Idaho
(Armstrong, R. L., *et al.*) 3 397

Geomorphology

Landform description, regional
(Toy, T. J.) 1 16
Shore features, Atlantic Coastal Plain
(Otvos, E. G., Jr., *et al.*) 5 734

USSR

Structural geology

Tectonics, structure, Siberia, Bering Strait, Pacific Ocean, Chukchi Sea
(Patton, W. W., Jr., *et al.*) 9 1298
Tectonics, structure, Siberia, Koryak Range
(Raskatov, G. I., *et al.*) 2 221

Utah

Geochronology

Absolute age, Precambrian, Oligocene, Miocene, northwest, Box Elder County, Raft River Mountains, Grouse Creek Mountains
(Compton, R. R., *et al.*) 9 1237

Petrology

Igneous rocks, volcanic rocks, Cenozoic, southwest, Washington County
(Hausel, W. D., *et al.*) 12 1831

Sedimentary petrology

Sedimentation, cyclic, sedimentary rocks, lithofacies, Cretaceous, Frontier Formation, north-central, Summit County, Coalville, Rockport
(Ryer, T. A.) 2 177

Structural geology

Tectonics, structure
(Stewart, J. H., *et al.*) 1 67

Venus
Geomorphology
Slopes, slabs, outcrops, surface materials, fines, lava, processes, erosion, degradation, mass transport, observations, photographs, Venera 9, Venera 10
(Florensky, C. P., *et al.*) 11 1537
Vermont
Geochemistry
Major elements, trace elements, metavolcanic rocks, Ordovician, Ammonoosuc Volcanics, Orange County, Windsor County, Connecticut Valley
(Aleinikoff, J. N.) 11 1546
Structural geology
Structural analysis, interpretation, central, Windsor County, Royalton
(Woodland, B. G.) 8 1111
Virginia
Sedimentary petrology
Sedimentation, provenance, sedimentary structures, sedimentary rocks, sandstone, Silurian, Tuscarora Sandstone, west, Valley and Ridge Province
(Whisonant, R. C.) 2 215
Volcanology
Volcanism
Age, absolute age, plate tectonics, Tertiary, middle Tertiary, Oligocene, Miocene, Mexico, Sierra Madre Occidental
(McDowell, F. W., *et al.*) 10 1479
Calderas, complexes, structure, eruptions, cycles, structural controls, petrology, geochemistry, tuff, lava flows, ash flows, magmas, differentiation, Miocene, Nevada, south
(Christiansen, R. L., *et al.*) 7 943
Eruptions, pyroclastics, ash flows, deposition, transport, petrography, Mississippian, Oklahoma, Arkansas, Ouachita Mountains
(Niem, A. R.) 1 49
Eruptions, stratovolcanoes, Quaternary, Oregon, Cascade Range, Metolius River region
(Scott, W. E.) 1 113
Evolution, plate tectonics, models, Cenozoic, Ethiopia, Afars and Issas Territory, Afar
(Barberi, F., *et al.*) 9 1251
Interpretation, magmas, subduction, rates, variations, Cenozoic, Pacific region, Aleutian Islands
(Price, C., *et al.*) 3 462
Volcanoes
United States, California, east, Mono Craters, Inyo Craters, Holocene, eruptions, tephrochronology, environmental geology, geologic hazards
(Wood. S. H.) 1 89
United States, Hawaii, Koko Crater, base surges, erosion, channels, U-shaped
(Fisher, R. V.) 9 1287
United States, Hawaii, Lanai, eruptions, lava flows, absolute age
(Bonhommet, N., *et al.*) 9 1282
Washington
Geochronology
Absolute age, Oligocene, Miocene, Mount Rainier National Park, Tatoosh Intrusion
(Mattinson, J. M.) 10 1509
Petrology
Metamorphism, prograde, igneous rocks, peridotite, north-central, Chelan County, Cascade Range, Darrington, Sultan
(Vance, J. A., *et al.*) 10 1497
Sedimentary petrology
Sediments, drift, Quaternary, Pierce County, Snohomish County, Mount Rainier, Nisqually Glacier, Paradise Glacier, South Cascade Glacier
(Mills, H. H.) 8 1135
Weathering
Analysis
Statistical analysis, source areas, rocks, types, erodibility, alluvial fans, size, California, Death Valley
(Hooke, R. L., *et al.*) 8 1177
Experimental studies
Iron, estimation, visual, saprolite, mineral composition, iron oxides, color
(Hurst, V. J.) 2 174
Wisconsin
Geomorphology
Fluvial features, southwest, Driftless Area, Lafayette County, Pecatonica River, Darlington
(Miller, T. K., *et al.*) 1 85
Wyoming
Geochronology
Absolute age, dates, Precambrian, north-central, Big Horn County, Sheridan County, Johnson County, Bighorn Mountains
(Stueber, A. M., *et al.*) 3 441
Absolute age, Precambrian, south, Carbon County, Sierra Madre
(Divis, A. F.) 1 96
Hydrogeology
Hydrology, rivers and streams, Absaroka Range, Park County, Shoshone River, North Fork
(Miller, W. R., *et al.*) 2 286
Sedimentary petrology
Sedimentation, transport, Holocene, modern, west, Sublette County, Daniel, Horse Creek
(Butler, P. R.) 8 1072

The Geological Society of America Bulletin
Author Index to Volume 88, No. 1-12, 1977

Ahmad, M. A. 8 1147
de Albuquerque, C. A. R. 10 1493
Aleinikoff, J. N. 11 1546
Alexander, D. H. 12 1785
Alvarez, W. 3 374
Alvarez, W. 3 383
Alvarez, W. 11 1694
Anderson, M. P. 6 895
Anthony, M. 7 920
Armstrong, R. L. 3 397
Arthaud, F. 9 1305
Arthur, M. A. 3 367
Arthur, M. A. 3 383
Atwater, T. 5 637
Austin, P. M. 8 1203
Baker, E. T. 11 1586
Baker, V. R. 8 1057
Ballard, R. D. 4 495
Ballard, R. D. 4 507
Barberi, F. 9 1251
Barker, D. S. 10 1421
Barker, D. S. 10 1428
Barker, D. S. 10 1437
Barrett, D. M. 6 749
Basilevsky, A. T. 11 1537
Baum, G. R. 6 869
Bazilevskiy, A. T. 11 1537
Beales, F. 12 1793
Beckinsale, R. D. 2 227
Beeby, D. J. 10 1378
Beeson, M. H. 9 1282
Berkebile, C. A. 6 895
Bhattacharyya, A. 11 1577
Black, R. F. 9 1331
Blank, H. R. 1 159
Bloxam, T. W. 3 480
Bohrer, D. 6 787
Bonhommet, N. 9 1282
Borns, H. W., Jr. 12 1773
Bouchez, J. L. 12 1740
Boulton, G. S. 7 1053
Bowman, D. 2 291
Briggs, P. 2 161
Brock, T. N. 3 465
Brock, W. G. 11 1667
Brook, C. A. 3 321
Bryan, W. B. 4 556
Bryan, W. B. 4 571
Buffington, E. C. 11 1567
Bull, W. B. 8 1199
Burba, G. A. 11 1537
Burchfiel, B. C. 11 1623
Burnett, W. C. 6 813
Butler, P. R. 8 1072
Butt, M. H. 8 1147
Byers, F. M., Jr. 7 943
Calkin, P. E. 12 1773
Capedri, S. 10 1493
Carpenter, G. B. 9 1337
Carr, M. J. 1 151
Carr, W. J. 7 943
Carson, B. 11 1586
Cebull, S. E. 10 1530
Chabrier, G. 11 1694
Chanda, S. K. 11 1577
Christiansen, R. L. 7 943
Churkin, M., Jr. 6 769
Cloud, P. E., Jr. 7 1050
Cobbing, E. J. 2 241
Compton, R. R. 9 1237
Cook, P. L. 8 1144
Cox, N. J. 8 1199
Craddock, C. 9 1217
Crill, P. A. 8 1161
Czamanske, G. K. 4 587
D'Allura, J. 6 844
Dalrymple, G. B. 9 1282
Damuth, J. E. 5 695
Davis, E. E. 3 346
Davis, G. A. 11 1623
Davis, G. H. 8 1211
Davis, S. N. 7 1054
Denny, C. S. 1 139
Dewey, J. F. 7 960
Divis, A. F. 1 96
Dixon, H. R. 7 925
Doig, R. 12 1843
Donahue, J. J. 12 1756
Donn, W. L. 3 390
Dostal, J. 10 1493
Drahovzal, J. A. 9 1368
Drever, J. I. 2 286
Duane, D. B. 5 734
Dubessy, J. 12 1740
Dungan, M. A. 10 1497
Dunne, G. C. 6 737
Durrell, C. 6 844
Dymond, J. 5 723
Easton, W. H. 10 1535
Eberlein, G. D. 6 769
Eldholm, O. 7 969
Eldholm, O. 7 1015
Embley, R. W. 5 683
Engelder, T. 11 1667
Erickson, A. J. 4 488
Etheridge, M. A. 6 873
Fallaw, W. C. 1 62
Farah, A. 8 1147
Fehn, U. 4 488
Ferguson, R. I. 2 212
Fetter, C. W., Jr. 6 895
Field, M. E. 5 734
Fischer, A. G. 3 367
Fischer, A. G. 3 383
Fisher, R. V. 9 1287
Fiske, R. S. 1 23
Florenskiy, K. P. 11 1537
Florensky, C. P. 11 1537
Flores, D. 12 1711
Folinsbee, R. E. 7 897
Fox, P. J. 4 600
Francis, T. J. G. 5 664
French, R. B. 12 1785
Frey, R. W. 12 1731
Fridleifsson, I. V. 11 1689
Fruchard, J. C. 12 1740
Gass, I. G. 12 1721
Gastil, R. G. 2 189
Gealey, W. K. 8 1183
Gibbs, R. J. 6 829
Goldsmith, R. 7 925
Goossens, P. J. 12 1711
Gray, D. F. 5 609
Green, K. E. 4 488
Green, K. E. 4 531
Gregory, K. J. 8 1075
Griffiths, J. R. 8 1203
Grow, J. A. 5 711
Guberman, Sh. A. 2 161
Gustavson, T. C. 1 159
Hadley, D. 10 1469
Hales, P. O. 3 397
Hall, S. A. 11 1593
Harris, R. L., Jr. 12 1828
Harris, W. B. 6 869
Hatcher, R. D., Jr. 11 1678
Hausel, W. D. 12 1831
Heath, G. R. 5 723
Heimlich, R. A. 3 441
Hein, J. R. 11 1567
Heirtzler, J. R. 4 481
Hendry, H. E. 6 809
Henry, T. W. 3 425
Hereford, R. 2 199
Herz, N. 1 101
Hey, R. 10 1385
Hey, R. 10 1404
Hickman, R. G. 9 1217
Higgins, M. W. 1 125
Hill, R. L. 10 1378
Hobart, M. A. 4 531
Hodges, F. N. 10 1428
Hodges, F. N. 10 1437
Holland, H. D. 4 488
Hollister, V. F. 12 1749
Hooke, R. L. 8 1177
Hoops, G. K. 10 1437
Houtz, R. E. 7 1030
Houtz, R. E. 5 711
Houtz, R. E. 5 720
Howard, A. D. 6 853
Hughes, G. W. 3 412
Hunt, R. E. 2 299
Huntoon, P. W. 11 1619
Hurst, V. J. 2 174
Joesten, R. 10 1515
Johannesson, H. 1 1
Johnson, G. L. 10 1385
Johnson, H. P. 5 637
Johnson, J. G. 10 1462
Johnson, M. E. 8 1192
Jongsma, D. 6 797
Juteau, T. 12 1740
Kalliokoski, J. 9 1375
Kanamori, H. 10 1469
Keizer, R. P. 10 1479
Kern, J. P. 11 1553
Kidd, W. S. F. 7 960
Kirk, W. S. 1 125
Kirkpatrick, R. J. 1 78
Knighton, A. D. 3 364
Koenig, M. 7 1000
Krall, D. B. 12 1697
Kristjansson, L. 1 1
Kristoffersen, Y. 7 1037
Krummenacher, D. 2 189
Kulm, L. D. 3 462
Kumar, N. 5 683
Kuntz, M. A. 3 465
Lattman, L. H. 7 1053
Lee, T.-C. 4 531
Lewan, M. D. 9 1375
Liou, J. G. 3 480
Lipman, P. W. 7 943
Lister, C. R. B. 3 346
Livingston, D. E. 12 1808
Long, L. E. 10 1437
Lowrie, A. 10 1385
Lowrie, W. 3 374
Lowrie, W. 3 383
Lozej, G. P. 12 1793
Ludwig, W. J. 5 711
Luyendyk, B. P. 5 621
Luyendyk, B. P. 5 648
Luyendyk, B. P. 9 1347
Lynts, G. W. 10 1447
Lyons, J. B. 12 1808
Macdonald, K. C. 4 541
Macdonald, K. C. 5 621
Macdonald, K. C. 5 648
MacQueen, J. A. 2 235
Maehle, S. 8 1124
Malin, M. C. 7 908
Marlow, M. 11 1567
Marlow, P. C. 6 873
Mascle, G. H. 11 1694
Matte, P. 9 1305
Mattinson, J. M. 10 1509
McDougall, I. 1 1
McDowell, F. W. 10 1479
McGhee, G. R., Jr. 6 806
McGill, G. E. 8 1102
McGrath, J. R. 5 664
McKee, E. H. 6 787
McLaren, D. J. 7 1050
Miller, T. K. 1 85
Miller, W. R. 2 286
Milliman, J. D. 5 711
Mills, H. H. 6 824
Mills, H. H. 8 1135
Mirza, M. A. 8 1147
Mitchell, A. H. G. 8 1081
Moore, J. G. 4 556
Moore, J. G. 4 587
Moore, W. J. 1 67
Moreland, G. 6 787
Moseley, F. 6 764
Mullins, H. T. 10 1447
Naeser, C. W. 8 1156
Naeser, C. W. 9 1237
Napoleone, G. 3 378
Napoleone, G. 3 383
Nash, W. P. 12 1831
Nasseef, A. O. 12 1721
Naylor, M. A. 10 1488
Neuman, S. P. 7 1054
Nicolas, A. 12 1740
Niem, A. R. 1 49
Nikolaeva, O. V. 11 1537
Nikolayeva, O. V. 11 1537
Nilsen, H. 8 1124
Nokleberg, W. 3 335
Oliver, H. W. 3 445

Oliver, W. A., Jr. 10 1462
Olsen, S. N. 8 1089
Onesti, L. J. 1 85
Orcutt, J. A. 5 678
Orkild, P. P. 7 943
Otvos, E. G., Jr. 5 734
Ozard, J. M. 2 241
Page, B. M. 3 480
Palmer, H. 2 299
Patton, W. W., Jr. 9 1298
Paul, D. K. 2 227
Pinet, P. R. 12 1731
Piper, D. J. W. 2 267
Platt, J. B. 3 480
Porter, I. T. 5 664
Potts, P. J. 2 227
Powell, D. 2 235
Premoli Silva, I. 3 371
Premoli Silva, I. 3 383
Press, F. 2 161
Price, C. 3 462
Proffett, J. M., Jr. 2 247
Pronin, A. A. 11 1537
Prothero, W. A. 5 678
Ramberg, H. 7 1051
Ramberg, I. B. 4 577
Ramberg, I. B. 5 609
Raskatov, G. I. 2 221
Raynolds, R. G. H. 5 609
Reid, I. 5 678
Reitan, P. H. 7 1051
Rennick, W. 9 1347
Rex, D. C. 2 227
Robertson, A. H. F. 12 1763
Robinson, G. R. 4 488
Roeder, D. 1 157
Roee, S. L. 8 1124
Roggenthen, W. M. 3 378
Roggenthen, W. M. 3 383
Rohrer, W. L. 8 1177
Ronca, L. B. 11 1537
Rose, W. I., Jr. 12 1711
Rubin, M. 1 139
Ruddiman, W. F. 12 1813
Russell, L. R. 10 1530
Russell, S. 3 335
Ryer, T. A. 2 177
Sacks, S. 1 23
Saemundsson, K. 1 1
Sargent, K. A. 7 943
Sarkar, S. 11 1577
Savin, S. M. 9 1321
Scheidegger, K. F. 3 462
Scholl, D. W. 11 1567
Schreiber, E. 4 600
Scott, W. E. 1 113
Seidemann, D. E. 11 1660
Shaw, C. E. 1 157
Shaw, C. E. 9 1368
Shaw, D. M. 3 390
Sherwood, K. W. 9 1217
Shevirov, L. T. 2 221
Sial, A. N. 8 1173
Siegel, M. D. 4 488
Sinha, A. K. 1 125
Sirkin, L. A. 1 139
Slatt, R. M. 2 267
Slatt, R. M. 9 1357
Smith, R. B. 2 312
Snelling, N. J. 2 241
Snoke, A. W. 11 1641
Soutar, A. 8 1161
Spinnangr, A. 8 1124
Stauffer, M. R. 6 809
Stearns, H. T. 10 1535
Steel, R. J. 8 1124
Stevens, C. H. 1 133
Stewart, J. H. 1 67
Stoiber, R. E. 1 151
Stokke, P. R. 11 1586
Stueber, A. M. 3 441
Sumner, J. R. 7 935
Sundeen, D. A. 8 1144
Sutherland, P. K. 3 425
Sweeney, J. F. 1 41
Swift, D. J. P. 2 299
Tailleur, I. L. 9 1298
Talwani, M. 7 969
Talwani, M. 7 1000
Talwani, M. 7 1015
Talwani, M. 7 1037
Taniguchi, D. 1 23
Taubeneck, W. H. 3 397
Thomas, W. A. 9 1368
Thorman, C. H. 8 1211
Tobisch, O. T. 1 23
Todd, V. R. 9 1237
Toy, T. J. 1 16
Trakhtman, A. M. 11 1537
Triplehorn, D. M. 8 1156
Tucholke, B. E. 9 1337
Turner, C. C. 3 412
Turner, D. L. 8 1156
Valencia, M. J. 1 143
Vallier, T. L. 6 787
van Andel, T. H. 4 481
van Andel, T. H. 4 495
van Andel, T. H. 4 507
van Andel, T. H. 4 577
Van der Voo, R. 12 1785
Vance, J. A. 10 1497
Varet, J. 9 1251
Varnes, D. J. 7 1055
Volkov, V. P. 11 1537
Von Herzen, R. P. 4 531
Walker, R. G. 2 273
Wallace, R. E. 9 1267
Watkins, N. D. 1 1
Welland, M. J. P. 8 1081
Whisonant, R. C. 2 215
White, W. M. 4 571
Wickham, J. 7 920
Williams, D. L. 4 488
Williams, D. L. 4 531
Willis, D. G. 6 883
Wilson, F. W. 7 1055
Windisch, C. 7 1030
Witherspoon, P. A. 7 1054
Wood, S. H. 1 89
Woodcock, N. H. 9 1231
Woodcock, N. H. 10 1488
Woodland, B. G. 8 1111
Wright, L. D. 6 857
Yeh, H.-W. 9 1321
Zartman, R. E. 1 125
Zartman, R. E. 9 1237
Zazetskiy, V. V. 11 1537
Zazetsky, V. V. 11 1537
Zietz, I. 1 67
Zietz, I. 7 925

ERRATA

Please substitute these pages for pages 1404 and 1406 in the October 1977 Bulletin, *v. 88, no. 10.*

Tectonic evolution of the Cocos-Nazca spreading center

RICHARD HEY* *Department of Geological and Geophysical Sciences, Princeton University, Princeton, New Jersey 08540*

ABSTRACT

Magnetic and bathymetric data from the eastern Pacific have been analyzed and a model for the evolution of the Galapagos region developed. The Farallon plate appears to have broken apart along a pre-existing Pacific-Farallon fracture zone, possibly the Marquesas fracture zone, at about 25 m.y. B.P. to form the Cocos and Nazca plates. This break is marked on the Nazca plate topographically by the Grijalva scarp and magnetically by a rough-smooth boundary coincident with the scarp. The oldest Cocos-Nazca magnetic anomalies parallel this boundary, implying that the early Cocos-Nazca spreading center trended east-northeast. This system soon reorganized into an approximately east-west rise–north-south transform configuration, which has persisted until the present, and the Pacific-Cocos-Nazca triple junction has since migrated north from its original location near lat 5°S. If correct, the combination of these simple geometric constraints produced the "enigmatic" east-trending anomalies south of the Carnegie Ridge.

The axes of the Cocos-Nazca spreading center and the Carnegie Ridge are essentially parallel; this can lead to paradoxical conclusions about interpretation of the Cocos and Carnegie Ridges as hotspot tracks. Hey and others (1977) have shown that recent accretion on the Cocos-Nazca spreading center has been asymmetric, resulting at least in part from small discrete jumps of the rise axis. I show here that the geometric objections to both the "hotspot" and "ancestral-ridge" hypotheses on the origin of the Cocos and Carnegie Ridges can be resolved with an asymmetric-accretion model. However, all forms of the ancestral-ridge hypothesis encounter more severe geometric difficulties, and these results support the hotspot hypothesis.

INTRODUCTION

The "instantaneous" plate motions in the east Pacific are apparently well known. Different people, working with different biases and often different data sets, have derived models quite consistent with each other, as well as being internally consistent (Hey and others, 1972, 1977; Herron, 1972; Morgan, 1973; Minster and others, 1974). These models predict both magnitudes and directions of relative plate motions and have been tested in many ways (Hey and others, 1972; Herron, 1972; Forsyth, 1972; Stover, 1973; Rea and others, 1973). Thus, on a gross scale, we appear to understand the present-day tectonic configuration. However, attempts to understand the details of the evolution of the present system have been less successful. The most obtrusive and controversial of the problem areas remains the Galapagos region, despite relatively high data density.

Herron and Heirtzler (1967) made the first guess at an evolutionary scheme for the Galapagos area, a guess that violated the rigid-plate hypothesis. Holden and Dietz (1972) pointed out this violation, but their reasoning was incorrect. They stated that the zone of compression suggested by Herron and Heirtzler (1967) and Raff (1968) is avoided by the requirement that two or possibly three of the rifts must spread obliquely, because "at triple junctions, seafloor spreading cannot be perpendicular to all three of the rifts" (Holden and Dietz, 1972, p. 267). In fact, spreading may be perpendicular to all three rifts without resulting zones of compression and without violation of the rigid-plate hypothesis.

Van Andel and others (1971) proposed that the aseismic Cocos and Carnegie Ridges were formed by rifting apart of a pre-existing ancestral ridge. This hypothesis has since undergone several modifications (Malfait and Dinkelman, 1972; Heath and van Andel, 1973; Rea and Malfait, 1974).

Holden and Dietz (1972) outlined a solution based on the hot spot hypothesis, in which the Cocos and Carnegie Ridges are regarded as hotspot traces formed as the Cocos and Nazca plates moved away from the Galapagos hotspot. This attempt, while instructive and partially successful conceptually, failed in detail for several reasons. Holden and Dietz misquoted Le Pichon (1968), confusing his America-Pacific pole with his Antarctica-Pacific pole and using that as a Nazca-Pacific pole. Using this invalid pole and an unreliable spreading-rate datum from Heirtzler and others (1968) (since reinterpreted) on the Pacific-Nazca rise, they calculated a spreading rate for the East Pacific (Pacific-Cocos) Rise north of the Pacific-Cocos-Nazca triple junction. This technique would only be valid if the Cocos-Nazca spreading center and triple junction itself did not exist. Solving for the Cocos-Nazca rotation rate, they predicted ages in the Panama basin that were so high they were used by Heath and van Andel (1973) to discredit the hotspot hypothesis.

After further elaboration of the hotspot hypothesis by Johnson and Lowrie (1972) and Hey and others (1973), Sclater and Klitgord (1973) examined both the hotspot and ancestral-ridge hypotheses and decided that both should be rejected, concluding that the Cocos and Carnegie Ridges "are not tectonically related" (p. 6973).

The difficulty in the Galapagos area arises primarily because the older magnetic anomalies have proven extremely difficult to correlate, surprisingly so considering the high data density and the ease with which the very young anomalies are correlated. An important problem is the reason for this difficulty in correlating older anomalies — either clearly recognizable anomalies were never formed here, or some mechanism has acted in this area to destroy them after they were formed.

On the basis of all available evidence, including new data presented here, I conclude that a model based on the hotspot hypothesis, with the modification of asymmetric accretion resulting at least in part from discrete jumps of the rise axis as discussed by Hey and others (1973) and demonstrated by Hey and others (1977), successfully meets the objection of Sclater and Klitgord (1973) and allows us to outline the history of the area from the break-up of the Farallon plate and birth of the Cocos-Nazca spreading center to the present. The "instantaneous" (a term Hey and others, 1977, have examined) configuration of plate boundaries and motions (Fig. 1) has generated a wedge of crust spread from the Cocos-Nazca spreading center, which is characterized by

* Present address: Hawaii Institute of Geophysics, University of Hawaii, Honolulu, Hawaii 96822.

Geological Society of America Bulletin, v. 88, p. 1404–1420, 9 figs., October 1977, Doc. no. 71003.

a slow spreading rate, rough topography, and strong magnetic anomalies. This wedge, termed the Galapagos gore by Holden and Dietz (1972) and discussed in detail by Hey and others (1977), is surrounded by crust spread from the Pacific-Cocos and Pacific-Nazca spreading centers which has the smooth morphology common to fast-spreading rises and low-amplitude magnetic anomalies, as both these segments of the East Pacific Rise are oriented nearly parallel to the Earth's magnetic field vector. My model explains the location and orientation of the magnetic and bathymetric rough-smooth boundaries that thus bound the gore and implies that there are two genetically different magnetic and bathymetric boundaries in the area.

EVOLUTION OF PACIFIC-COCOS-NAZCA TRIPLE JUNCTION

McKenzie and Morgan (1969) assumed for simplicity that all rises spread symmetrically and nonobliquely. They were then able to show that all rise-rise-rise (RRR) triple junctions are stable under these assumptions. The stability criterion for the more general case of oblique spreading has been discussed by McKenzie and Sclater (1971), and for the yet more general case of asymmetric, oblique spreading by Johnson and others (1973). An RRR junction is stable (in the McKenzie-Morgan sense) only if a frame of reference exists in which the geometries of all three pairs of relative plate motions remain simultaneously unchanged. This frame of reference is thus fixed relative to the junction, which in general will be moving relative to the mantle. Figure 2 shows the instantaneous vector velocity triangle for the Galapagos triple junction. The vectors **P-M, C-M,** and **N-M** show the instantaneous velocities of the Pacific, Cocos, and Nazca plates relative to the Galapagos hotspot predicted by model PAM1 (Hey and others, 1977). The vectors **C-P, N-P,** and **C-N** show the predicted relative motions of these plates at the junction. The vector **J-M** shows the calculated velocity of the triple junction over the mantle (assuming hotspots to be fixed in the mantle). The vectors **C-J, N-J,** and **P-J** show the motions of the plates relative to the junction and thus predict the recent azimuths of the isochron flexures (rough-smooth boundaries) that separate crust spread from the various rises. The triangle is in velocity space. The dashed lines pc, pn, and cn in Figure 2 are an approximation to the frames of reference in which the respective relative geometries remain unchanged. These lines would be the perpendicular bisectors of the sides of the velocity triangle for the special case of symmetric, nonoblique spreading (McKenzie and Morgan, 1969), which is probably occurring on none of these rises at present, although I have constructed the frames of reference as though it were. More generally, frames of reference must be constructed parallel to their respective plate boundaries through points on the relative-motion vectors determined by the percentage of asymmetric spreading. The junction is stable only if these dashed lines intersect in a point, which shows the instantaneous velocity of the triple junction. The Cocos-Nazca spreading center away from the junction is probably now spreading slightly asymmetrically or jumping, with a maximum obliqueness angle, measured between the transform-fault azimuths and local perpendiculars to the rise axis, of about 10°. If this is also true at the junction, then in order for this junction to be continuously stable, the Pacific-Cocos and (or) the Pacific-Nazca spreading center must be accreting asymmetrically and (or) obliquely in a highly constrained geometry (although from our measurements this exact geometry is poorly defined). As asymmetric accretion has been reported on both rises (Heinrichs and Lu, 1970; Herron, 1972), and considering the uncertainties in rates involved, this could easily be a stable junction at present. Alternatively, it is possible that the junction could achieve long-term stability through discontinuous adjustments (such as rise jumps) to a geometry instantaneously unstable. McKenzie and Parker (1974) have pointed out that it is unlikely that a junction stable in velocity space will be stable in acceleration space. Short-term instabilities in velocity space could conceivably be resolved with compensating accelerations; a possible example of this is seen near the South America–Africa–Antarctica triple junction (Sclater and others, 1976). Instantaneously, the Pacific-Cocos-Nazca triple junction is moving about 5 mm/yr to the north and about 17 mm/yr to the west relative to the hotspot. It is interesting to note that the *junction* was creating the high escarpments bordering Hess Deep approximately 1 m.y. B.P., as the Cocos-Nazca spreading center is growing at a rate of about 68 mm/yr.

McKenzie and Parker (1974) have defined a triple-junction vector as a vector at right angles to the vector velocity triangle; the magnitude of the triple-junction vector is the area of the velocity triangle. The vector velocity triangle in Figure 2 is divided into three triangles by vectors P-J, C-J, and N-J. The area of each of these triangles represents the rate at which new material is created on the new parts of the respective rises. The magnitude of this

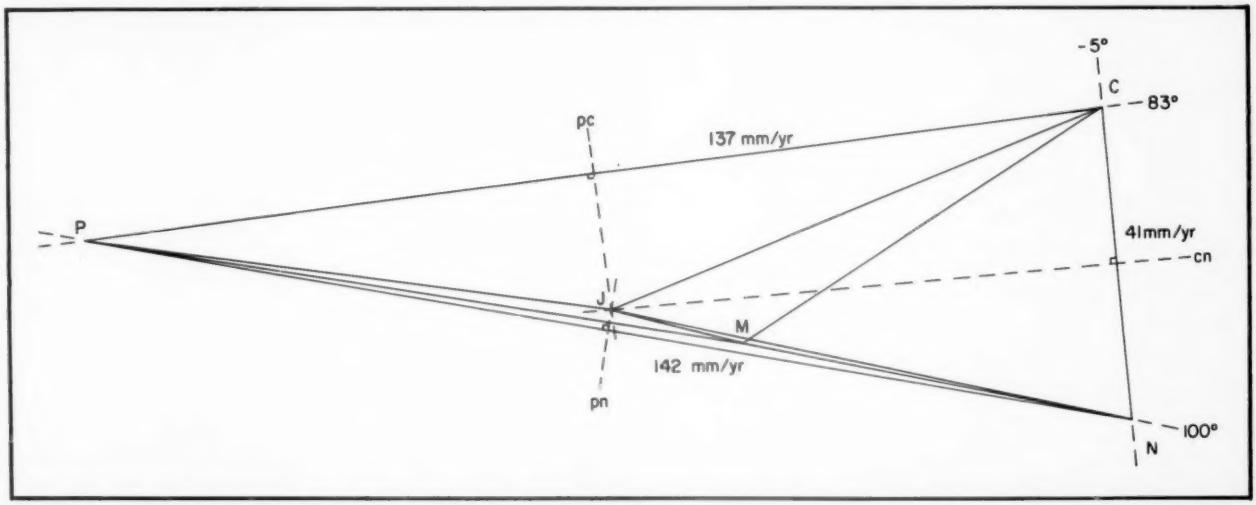


Figure 2. Instantaneous vector velocity triangle for Pacific-Cocos-Nazca triple junction. All instantaneous rates and azimuths are from model PAM1 (Hey and others, 1977). Vectors **P-C, C-N,** and **P-N** show relative plate motions at triple junction (rates and azimuths given refer to these motions). Vectors **P-M, C-M,** and **N-M** show plate motions relative to hotspot reference frame. Vectors **P-J, C-J,** and **N-J** show plate motions relative to triple junction. Vector **J-M** gives motion of junction relative to hotspots. Points along dashed lines pc, cn, and pn have vector velocities that leave geometry of **P-C, C-N,** and **P-N,** respectively, unchanged (McKenzie and Morgan, 1969). Triangle is in velocity space.

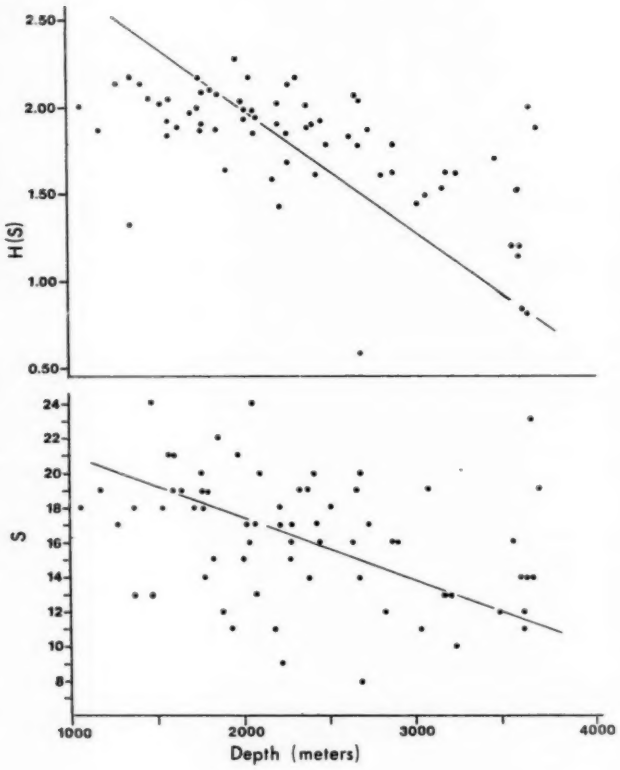
Other ERRATA

Volume 87

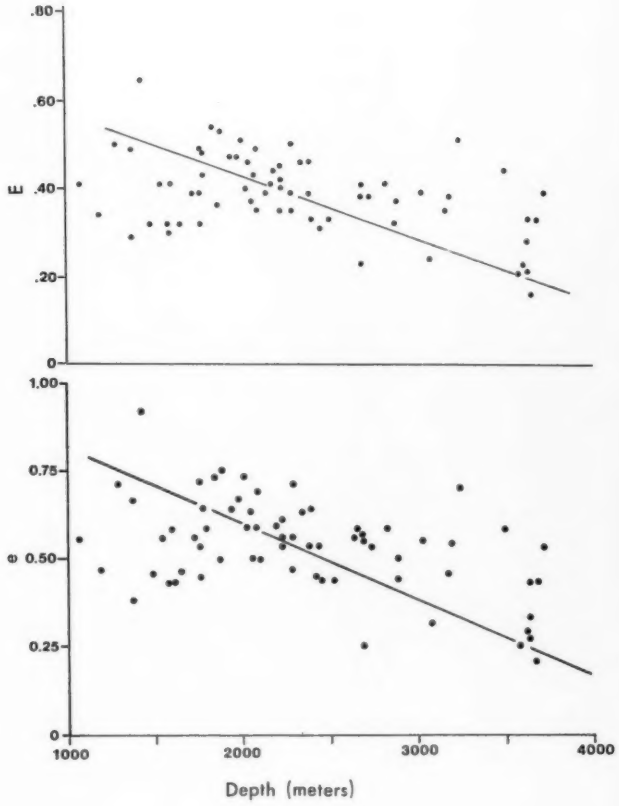
Page 1679, middle column, line 2, "35 percent" should read "35 permil".

Page 1681

Corrected Figure 4



Corrected Figure 5



Volume 88

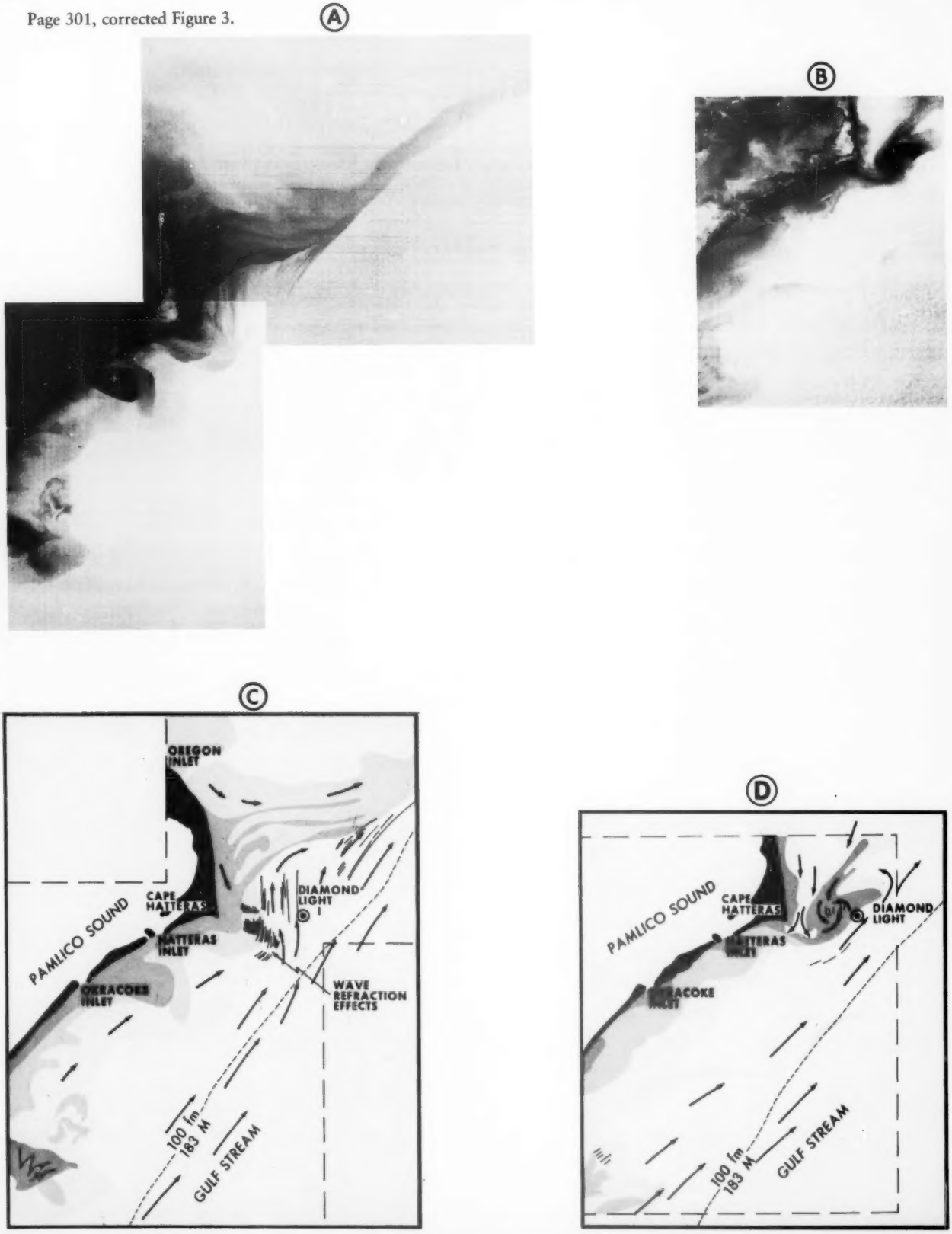
Page 264, column 2, line 11, "The continental crust of the Red Sea area consists of a complex of Mesozoic granitic and metamorphic rocks" should read "The continental crust of the Red Sea area consists of a complex of Precambrian granitic and metamorphic rocks and in the Gulf of California area consists of a complex of Mesozoic granitic and metamorphic rocks."

Page 364, correct equation 7 should read:

$$\beta = \frac{Sxy}{n\sigma^2_x} \text{ and } \rho = \frac{Sxy}{n\sigma_x\sigma_y}$$

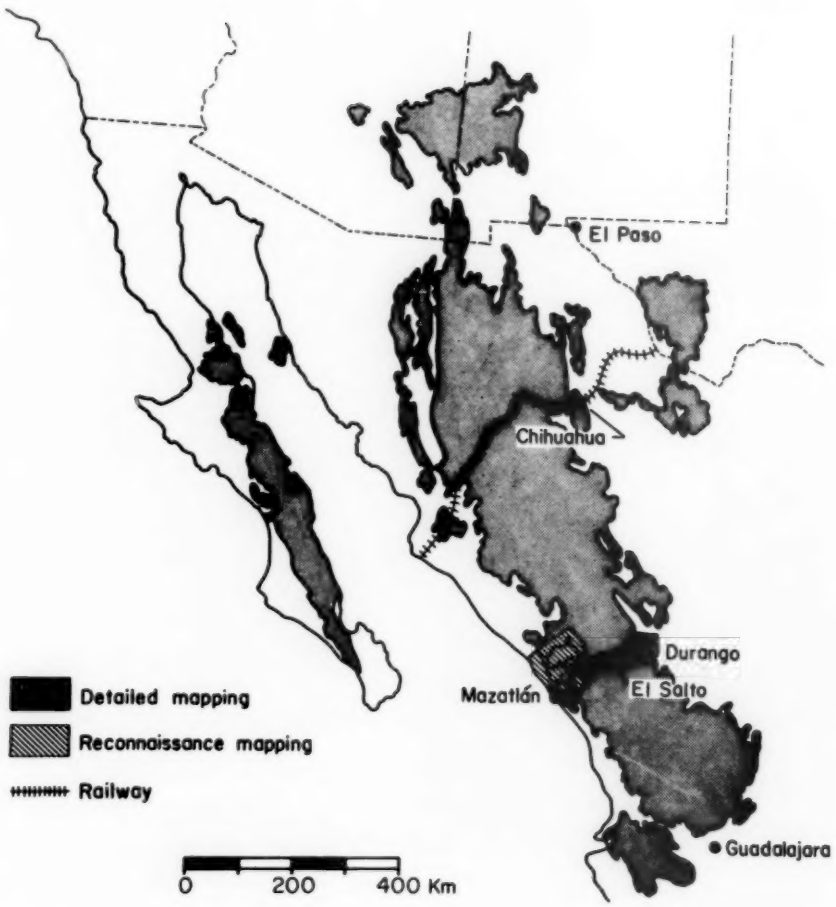
Volume 88

Page 301, corrected Figure 3.



Volume 88

Page 1479, corrected Figure 1.



Geological Society of America Bulletin

Contents

Volume 88

(JANUARY-JUNE)

PUBLISHED IN BOULDER, COLORADO
BY
THE SOCIETY
1977

Contents (January–June) 1977

JANUARY

Extension of the geomagnetic polarity time scale to 6.5 m.y.: K-Ar dating, geological and paleomagnetic study of a 3,500-m lava succession in western Iceland ..... *Ian McDougall, Kristjan Saemundsson, Haukur Johannesson, Norman D. Watkins, and Leo Kristjansson* 1–15

Hillslope form and climate ..... *Terrence J. Toy* 16–22

Strain in metamorphosed volcaniclastic rocks and its bearing on the evolution of orogenic belts .. *Othmar T. Tobisch, Richard S. Fiske, Steven Sacks, and Dennis Taniguchi* 23–40

Subsidence of the Sverdrup Basin, Canadian Arctic Islands .. .. *J. F. Sweeney* 41–48

Mississippian pyroclastic flow and ash-fall deposits in the deep-marine Ouachita flysch basin, Oklahoma and Arkansas . ..... *Alan R. Niem* 49–61

Trends in trans–North Atlantic commonality among Phanerozoic invertebrates, and plate tectonic events .... *W. C. Fallaw* 62–66

East-west patterns of Cenozoic igneous rocks, aeromagnetic anomalies, and mineral deposits, Nevada and Utah .... *John H. Stewart, William J. Moore, and Isidore Zietz* 67–77

Nucleation and growth of plagioclase, Makaopuhi and Alae lava lakes, Kilauea Volcano, Hawaii .... *R. James Kirkpatrick* 78–84

Multivariate empirical test of the Leopold and Miller stream order–hydraulic geometry hypothesis .... *Theodore K. Miller and Lawrence J. Onesti* 85–88

Distribution, correlation, and radiocarbon dating of late Holocene tephra, Mono and Inyo craters, eastern California . ..... *Spencer H. Wood* 89–95

Isotopic studies on a Precambrian geochronologic boundary, Sierra Madre Mountains, Wyoming ..... *Allan F. Divis* 96–100

Timing of spreading in the South Atlantic: Information from Brazilian alkalic rocks ..... *Norman Herz* 101–112

Quaternary glaciation and volcanism, Metolius River area, Oregon ..... *William E. Scott* 113–124

U-Pb zircon dates from the central Appalachian Piedmont: A possible case of inherited radiogenic lead .... *Michael W. Higgins, Akhaury K. Sinha, Robert E. Zartman, and William S. Kirk* 125–132

Was development of brackish oceans a factor in Permian extinctions? ..... *Calvin H. Stevens* 133–138

Late Pleistocene environment of the central Delmarva Peninsula, Delaware-Maryland ..... *Leslie A. Sirkin, Charles S. Denny, and Meyer Rubin* 139–142

Pleistocene stratigraphy of the western equatorial Pacific .... *Mark J. Valencia* 143–150

Geologic setting of some destructive earthquakes in Central America ..... *Michael J. Carr and Richard E. Stoiber* 151–156

Large-scale recumbent folding in the valley and ridge province of Alabama: Discussion and reply
Discussion ..... *Dietrich Roeder*
Reply ..... *Charles Shaw* 157–158

Paleotemperature analysis of the marine Pleistocene of Long Island, New York, and Nantucket Island, Massachusetts: Discussion and reply
Discussion ..... *Horace R. Blank*
Reply ..... *Thomas C. Gustavson* 159–160

FEBRUARY

Pattern recognition applied to earthquake epicenters in California and Nevada ..... *Peter Briggs, Frank Press, and Sh. A. Guberman* 161–173

Visual estimation of iron in saprolite ..... *Vernon J. Hurst* 174–176

Patterns of Cretaceous shallow-marine sedimentation, Coalville and Rockport areas, Utah ..... *Thomas A. Ryer* 177–188

Reconnaissance geology of coastal Sonora between Puerto Lobos and Bahia Kino ..... *R. Gordon Gastil and Daniel Krummenacher* 189–198

Deposition of the Tapeats Sandstone (Cambrian) in central Arizona ..... *Richard Hereford* 199–211

Meander sinuosity and direction variance .... *R. I. Ferguson* 212–214

Lower Silurian Tuscarora (Clinch) dispersal patterns in western Virginia ..... *Robert C. Whisonant* 215–220

Neotectonic transverse structures of mobile belts: A study of an example of their deep tectonic relationships in the Koryak region, northwest Pacific margin ..... *G. I. Raskotov and L. T. Shevirov* 221–226

Geochemical and petrogenetic study of the Girnar igneous complex, Deccan volcanic province, India ... *D. K. Paul, P. J. Potts, D. C. Rex, and R. D. Beckinsale* 227–234

Relationships between deformation and garnet growth in Moine (Precambrian) rocks of western Scotland .... *J. A. MacQueen and Derek Powell* 235–240

Reconnaissance geochronology of the crystalline basement rocks of the Coastal Cordillera of southern Peru .... *E. J. Cobbing, J. M. Ozard, and N. J. Snelling* 241–246

Cenzoic geology of the Yerington district, Nevada, and implications for the nature and origin of Basin and Range faulting ..... *John M. Proffett, Jr.* 247–266

Late Quaternary clay-mineral distribution on the eastern continental margin of Canada ..... *David J. W. Piper and Roger M. Slatt* 267–272

Deposition of upper Mesozoic resedimented conglomerates and associated turbidites in southwestern Oregon .... *Roger G. Walker* 273–285

Water chemistry of a stream following a storm, Absaroka Mountains, Wyoming ..... *William R. Miller and James I. Drever* 286–290

Stepped-bed morphology in arid gravelly channels .... *D. Bowman* 291–298

Constructional shelf topography, Diamond Shoals, North Carolina ..... *Robert E. Hunt, Donald J. P. Swift, and Harold Palmer* 299–311

Formation of folds, boudinage, and mullions in non-Newtonian materials ..... *R. B. Smith* 312–320

CONTENTS

MARCH

Stratigraphy and structure of the Saddlebag Lake roof pendant, Sierra Nevada, California ..... *Charles A. Brook* 321–334

Superimposition and timing of deformations in the Mount Morrison roof pendant and in the central Sierra Nevada, California ..... *Stephen Russell and Warren Nokleberg* 335–345

Tectonic structures on the Juan de Fuca Ridge ..... *E. E. Davis and C.R.B. Lister* 346–363

Alternative derivation of the minimum variance hypothesis .. *A. D. Knighton* 364–366

Upper Cretaceous–Paleocene magnetic stratigraphy at Gubbio, Italy .....

I. Lithostratigraphy and sedimentology ..... *Michael A. Arthur and Alfred G. Fischer*

II. Biostratigraphy ..... *Isabella Premoli Silva*

III. Upper Cretaceous magnetic stratigraphy ..... *William Lowrie and Walter Alvarez*

IV. Upper Maastrichtian–Paleocene magnetic stratigraphy ..... *William M. Roggenthen and Giovanni Napoleone*

V. Type section for the late Cretaceous–Paleocene geomagnetic reversal time scale ..... *Walter Alvarez, Michael A. Arthur, Alfred G. Fischer, William Lowrie, Giovanni Napoleone, Isabella Premoli Silva, and William M. Roggenthen* 367–389

Model of climate evolution based on continental drift and polar wandering . *William L. Donn and David M. Shaw* 390–396

Rb-Sr and K-Ar geochronometry of Mesozoic granitic rocks and their Sr isotopic composition, Oregon, Washington, and Idaho ..... *Richard Lee Armstrong, William H. Taubeneck, and Peter O. Hales* 397–411

Upraised Pacific Ocean floor, southern Malaita, Solomon Islands ..... *G. Wyn Hughes and Colin C. Turner* 412–424

Carbonate platform facies and new stratigraphic nomenclature of the Morrowan Series (Lower and Middle Pennsylvanian), northeastern Oklahoma ..... *Patrick K. Sutherland and Thomas W. Henry* 425–440

Rb-Sr isochron age of the Precambrian basement complex, Bighorn Mountains, Wyoming ..... *Alan M. Stueber and Richard A. Heimlich* 441–444

Gravity and magnetic investigations of the Sierra Nevada batholith, California ..... *Howard W. Oliver* 445–461

Late Cenozoic volcanism in the Aleutian Arc: Information from ash layers in the northeastern Gulf of Alaska: Discussion and reply

Discussion ..... *Chadderdon Price*

Reply ..... *K. F. Scheidegger and L. D. Kulm* 462–464

Structure, petrology, and petrogenesis of the Treasurevault stock, Mosquito Range, Colorado ... *Mel A. Kuntz and Thomas N. Brock* 465–479

Franciscan blueschist-facies metaconglomerates, Diablo Range, California: Discussion and reply

Discussion ..... *T. W. Bloxam*

Reply .... *Jeremy B. Platt, J. G. Liou, and Ben M. Page* 480

APRIL

Project FAMOUS: Its origin, programs, and setting ..... *J. R. Heirtzler and Tjeerd H. van Andel* 481–487

Deep-water temperatures in the FAMOUS area ..... *U. Fehn, M. D. Siegel, G. R. Robinson, H. D. Holland, D. L. Williams, A. J. Erickson, and K. E. Green* 488–494

Project FAMOUS: Operational techniques and American submersible operations ..... *Robert D. Ballard and Tjeerd H. van Andel* 495–506

Morphology and tectonics of the inner rift valley at lat 36°50′N on the Mid-Atlantic Ridge ..... *Robert D. Ballard and Tjeerd H. van Andel* 507–530

A geothermal study of the Mid-Atlantic Ridge near 37°N ... *David L. Williams, Tien-Chang Lee, Richard P. Von Herzen, Kenneth E. Green, and Michael A. Hobart* 531–540

Near-bottom magnetic anomalies, asymmetric spreading, oblique spreading, and tectonics of the Mid-Atlantic Ridge near lat 37°N ..... *Ken C. Macdonald* 541–555

Compositional variations of young basalts in the Mid-Atlantic Ridge rift valley near 36°49′N ..... *W. B. Bryan and James G. Moore* 556–570

Sr-isotope, K, Rb, Cs, Sr, Ba, and rare-earth geochemistry of basalts from the FAMOUS area ..... *William M. White and W. B. Bryan* 571–576

Morphology and tectonic evolution of the rift valley at lat 36°30′N, Mid-Atlantic Ridge ..... *Ivar B. Ramberg and Tjeerd H. van Andel* 577–586

Composition and phase chemistry of sulfide globules in basalt from the Mid-Atlantic Ridge rift valley near 37°N lat ... *Gerald K. Czamanske and James G. Moore* 587–599

Density and *P*-wave velocity of rocks from the FAMOUS region and their implication to the structure of the oceanic crust ..... *Edward Schreiber and Paul J. Fox* 600–608

CONTENTS

MAY

Tectonic evolution of the FAMOUS area of the Mid-Atlantic Ridge, lat 35°50′ to 37°20′N ..... *Ivar B. Ramberg, Dale F. Gray, Robert G. H. Raynolds* 609–620

Deep-tow studies of the structure of the Mid-Atlantic Ridge crest near lat 37°N ..... *Ken C. Macdonald and Bruce P. Luyendyk* 621–636

Magnetic study of basalts from the Mid-Atlantic Ridge, lat 37°N ..... *H. Paul Johnson and Tanya Atwater* 637–647

Physiography and structure of the inner floor of the FAMOUS rift valley: Observations with a deep-towed instrument package ..... *Bruce P. Luyendyk and Ken C. Macdonald* 648–663

Ocean-bottom seismograph observations on the Mid-Atlantic Ridge near lat 37°N ..... *T.J.G. Francis, I. T. Porter, and J. R. McGrath* 664–677

Seismic evidence for a narrow zone of partial melting underlying the East Pacific Rise at 21°N ..... *Ian Reid, John A. Orcutt, and William A. Prothero* 678–682

Evolution and origin of Ceará Rise: An aseismic rise in the western equatorial Atlantic ..... *Naresh Kumar and Robert W. Embley* 683–694

Late Quaternary sedimentation in the western equatorial Atlantic ..... *John E. Damuth* 695–710

Structure of the northern Brazilian continental margin ..... *R. E. Houtz, W. J. Ludwig, J. D. Milliman, and J. A. Grow* 711–719

Sound-velocity characteristics of sediment from the eastern South American margin ..... *Robert E. Houtz* 720–722

Genesis and transformation of metalliferous sediments from the East Pacific Rise, Bauer Deep, and Central Basin, northwest Nazca plate ..... *G. Ross Heath and Jack Dymond* 723–733

Post-Pleistocene history of the United States inner continental shelf: Significance to origin of barrier islands: Discussion and reply

Discussion ..... *Ervin G. Otvos, Jr.*

Reply ..... *Michael E. Field and David B. Duane* 734–736

JUNE

Geology and structural evolution of Old Dad Mountain, Mojave Desert, California ..... *George C. Dunne* 737–748

Agulhas Plateau off southern Africa: A geophysical study ..... *Douglas M. Barrett* 749–763

Caledonian plate tectonics and the place of the English Lake District ..... *Frank Moseley* 764–768

Ancient borderland terranes of the North American Cordillera: Correlation and microplate tectonics ..... *Michael Churkin, Jr. and G. Donald Eberlein* 769–786

Origin of basalt microlapilli in lower Miocene pelagic sediment, northeastern Pacific Ocean ..... *T. L. Vallier, Dennis Bohrer, Grover Moreland, and Edwin H. McKee* 787–796

Bathymetry and shallow structure of the Pliny and Strabo Trenches, south of the Hellenic Arc ..... *Derk Jongsma* 797–805

The Frasnian-Famennian (Late Devonian) boundary within the Foreknobs Formation, Maryland and West Virginia ..... *George R. McGhee, Jr.* 806–808

Penecontemporaneous folds in cross-bedding: Inversion of facing criteria and mimicry of tectonic folds ..... *Hugh E. Hendry and Mel R. Stauffer* 809–812

Geochemistry and origin of phosphorite deposits from off Peru and Chile ..... *William C. Burnett* 813–823

Basal till fabrics of modern alpine glaciers ... *Hugh H. Mills* 824–828

Transport phases of transition metals in the Amazon and Yukon Rivers ..... *Ronald J. Gibbs* 829–843

Upper Paleozoic section in eastern Plumas and Sierra Counties, northern Sierra Nevada, California ..... *Cordell Durrell and Jad D'Allura* 844–852

Effect of slope on the threshold of motion and its application to orientation of wind ripples ..... *Alan D. Howard* 853–856

Sediment transport and deposition at river mouths: A synthesis ..... *L. D. Wright* 857–868

Foraminifera and Rb-Sr glauconite ages of a Paleocene Beaufort Formation outcrop in North Carolina ..... *W. Burleigh Harris and Gerald R. Baum* 869–872

Development of a layered crenulation cleavage in mica schists of the Kanmantoo Group near Macclesfield, South Australia ..... *P. C. Marlow and M. A. Etheridge* 873–882

Kinematic model of preferred orientation ... *David G. Willis* 883–894

Hydrogeology of the South Fork of Long Island, New York: Discussion and reply

Discussion ..... *M. P. Anderson and C. Alan Berkebile*

Reply ..... *C. W. Fetter, Jr.* 895–896

Geological Society of America
Bulletin

Contents
Volume 88
(JULY–DECEMBER)

PUBLISHED IN BOULDER, COLORADO
BY
THE SOCIETY
1977

Contents (July/December) 1977

JULY

World's view — from Alph to Zipf ..... *R. E. Folinsbee* 897–907

Comparison of volcanic features of Elysium (Mars) and Tibesti (Earth) ..... *Michael C. Malin* 908–919

Strain paths and folding of carbonate rocks near Blue Ridge, central Appalachians ..... *John Wickham and Mike Anthony* 920–924

Correlation of aeroradioactivity and geology in southeastern Connecticut and adjacent New York and Rhode Island ..... *Richard Goldsmith, Isidore Zietz, and H. R. Dixon* 925–934

Geophysical investigation of the structural framework of the Newark-Gettysburg Triassic basin, Pennsylvania ..... *John Randolph Sumner* 935–942

Timber Mountain–Oasis Valley caldera complex of southern Nevada ..... *Robert L. Christiansen, Peter W. Lipman, W. J. Carr, F. M. Byers, Jr., Paul P. Orkild, and K. A. Sargent* 943–959

Geometry of plate accretion ..... *J. F. Dewey and W.S.F. Kidd* 960–968

Evolution of the Norwegian-Greenland Sea ..... *Manik Talwani and Olav Eldholm* 969–999

A geophysical study of the southern continental margin of Australia: Great Australian Bight and western sections ..... *Michael König and Manik Talwani* 1000–1014

Sediment distribution and structural framework of the Barents Sea ..... *Olav Eldholm and Manik Talwani* 1015–1029

Barents Sea continental margin sonobuoy data ..... *R. Houtz and C. Windisch* 1030–1036

Extinct triple junction south of Greenland and the Tertiary motion of Greenland relative to North America ..... *Yngve Kristoffersen and Manik Talwani* 1037–1049

Medals and awards for 1976 1050–1056

AUGUST

Stream-channel response to floods, with examples from central Texas ..... *Victor R. Baker* 1057–1071

Movement of cobbles in a gravel-bed stream during a flood season ..... *Paul Ray Butler* 1072–1074

Stream network volume: An index of channel morphometry ..... *K. J. Gregory* 1075–1080

Emplacement of the Oman ophiolite: A mechanism related to subduction and collision ..... *Michael J. P. Welland and A.H.G. Mitchell* 1081–1088

Origin of the Baltimore Gneiss migmatites at Piney Creek, Maryland ..... *Sakiko N. Olsen* 1089–1101

Craters as "fossils": The remote dating of planetary surface materials ..... *George E. McGill* 1102–1110

Structural analysis of the Silurian-Devonian rocks of the Royalton area, Vermont ..... *Bertram G. Woodland* 1111–1123

Coarsening-upward cycles in the alluvium of Hornelen Basin (Devonian), Norway: Sedimentary response to tectonic events ..... *R. J. Steel, S. Mæhle, H. Nilsen, S. L. Røe, and A. Spinnangr* 1124–1134

Textural characteristics of drift from some representative Cordilleran glaciers ..... *Hugh H. Mills* 1135–1143

K-Ar dates from Upper Cretaceous volcanic rocks in the subsurface of west-central Mississippi ..... *Daniel A. Sundeen and Philip L. Cook* 1144–1146

Gravity field of the buried shield in the Punjab Plain, Pakistan ..... *Abul Farah, Mohammad A. Mirza, Mohammad A. Abmad, and Mohammad H. Butt* 1147–1155

K-Ar and fission-track dating of ash partings in coal beds from the Kenai Peninsula, Alaska: A revised age for the Homerian Stage–Clamgulchian Stage boundary ..... *Don M. Triplehorn, Donald L. Turner, and Charles W. Naeser* 1156–1160

Sedimentation and climatic patterns in the Santa Barbara Basin during the 19th and 20th centuries ..... *Andrew Soutar and Peter A. Crill* 1161–1172

Petrology and mineral chemistry of peridotite nodules included in Tertiary basaltic rocks of northeast Brazil ..... *Alcides Nóbrega Sial* 1173–1176

Relative erodibility of source-area rock types, as determined from second-order variations in alluvial-fan size ..... *Roger LeB. Hooke and William L. Rohrer* 1177–1182

Ophiolite obduction and geologic evolution of the Oman Mountains and adjacent areas ..... *W. K. Gealey* 1183–1191

Geology in American education: 1825–1860 ..... *Markes E. Johnson* 1192–1198

Allometric change of landforms: Discussion and reply
Discussion ..... *Nicholas J. Cox*
Reply ..... *William B. Bull* 1199–1202

Paleogeographic and paleotectonic models for the New Zealand geosyncline in eastern Gondwanaland: Discussion and reply
Discussion ..... *John R. Griffiths*
Reply ..... *Peter M. Austin* 1203–1210

Gravity-induced folding off a gneiss dome complex, Rincon Mountains, Arizona: Discussion and reply
Discussion ..... *C. H. Thorman*
Reply ..... *George H. Davis* 1211–1216

CONTENTS

SEPTEMBER

Structural geology of the Nenana River segment of the Denali fault system, central Alaska Range ..... *Robert G. Hickman, Campbell Craddock, and Kirk W. Sherwood* 1217–1230

Specification of fabric shapes using an eigenvalue method .. .. *N. H. Woodcock* 1231–1236

Oligocene and Miocene metamorphism, folding, and low-angle faulting in northwestern Utah ..... *Robert R. Compton, Victoria R. Todd, Robert E. Zartman, and Charles W. Naeser* 1237–1250

Volcanism of Afar: Small-scale plate tectonics implications . ..... *Franco Barberi and Jacques Varet* 1251–1266

Profiles and ages of young fault scarps, north-central Nevada ..... *Robert E. Wallace* 1267–1281

A contribution to the geochronology and petrology of the island of Lanai, Hawaii ..... *Norbert Bonhommet, Melvin H. Beeson, and G. Brent Dalrymple* 1282–1286

Erosion by volcanic base-surge density currents: U-shaped channels ..... *Richard V. Fisher* 1287–1297

Evidence in the Bering Strait region for differential movement between North America and Eurasia ..... *William W. Patton, Jr. and Irvin L. Tailleur* 1298–1304

Late Paleozoic strike-slip faulting in southern Europe and northern Africa: Result of a right-lateral shear zone between the Appalachians and the Urals ..... *François Arthaud and Philippe Matte* 1305–1320

Mechanism of burial metamorphism of argillaceous sediments: 3. O-isotope evidence .... *Hsueh-Wen Yen and Samuel M. Savin* 1321–1330

Regional stagnation of ice in northeastern Connecticut: An alternative model of deglaciation for part of New England ..... *Robert F. Black* 1331–1336

Sediment distribution and Cenozoic sedimentation patterns on the Agulhas Plateau ..... *Brian E. Tucholke and George B. Carpenter* 1337–1346

Tectonic history of aseismic ridges in the eastern Indian Ocean ..... *Bruce P. Luyendyk and Walter Rennick* 1347–1356

Late Quaternary terrigenous and carbonate sedimentation on Grand Bank of Newfoundland .... *Roger M. Slatt* 1357–1367

Large-scale recumbent folding in the Valley and Ridge province of Alabama: Discussion and reply

Discussion ..... *William A. Thomas and James A. Drahovzal*

Reply ..... *Charles E. Shaw* 1368–1374

Chemistry and mineralogy of Precambrian paleosols in northern Michigan: Discussion and reply

Discussion ..... *M. D. Lewan*

Reply ..... *J. Kalliokoski* 1375–1376

OCTOBER

Announcement 1377

Surface faulting associated with the 5.2 magnitude Galway Lake earthquake of May 31, 1975: Mojave Desert, San Bernardino County, California ..... *Robert L. Hill and David J. Beeby* 1378–1384

Recent plate motions in the Galapagos area ..... *Richard Hey, G. Leonard Johnson, and Allen Lowrie* 1385–1403

Tectonic evolution of the Cocos-Nazca spreading center ... . *Richard Hey* 1404–1420

Northern Trans-Pecos magmatic province: Introduction and comparison with the Kenya rift ..... *Daniel S. Barker* 1421–1427

Mineralogy of intrusions in the Diablo Plateau, northern Trans-Pecos magmatic province, Texas and New Mexico ..... *Daniel S. Barker and Floyd N. Hodges* 1428–1436

Petrology and Rb-Sr isotope geochemistry of intrusions in the Diablo Plateau, northern Trans-Pecos magmatic province, Texas and New Mexico ..... *Daniel S. Barker, Leon E. Long, G. Karl Hoops, and Floyd N. Hodges* 1437–1446

Origin of the northwestern Bahama Platform: Review and reinterpretation ..... *Henry T. Mullins and George W. Lynts* 1447–1461

Silurian and Devonian coral zones in the Great Basin, Nevada and California ... *J. G. Johnson and W. A. Oliver, Jr.* 1462–1468

Seismic structure of the Transverse Ranges, California ..... *David Hadley and Hiroo Kanamori* 1469–1478

Timing of mid-Tertiary volcanism in the Sierra Madre Occidental between Durango City and Mazatlán, Mexico . ..... *Fred W. McDowell and Richard P. Keizer* 1479–1487

Transition analysis of structural sequences ..... *M. A. Naylor and N. H. Woodcock* 1488–1492

Mineralogy of spinel peridotite inclusions of alkali basalts from Sardinia ..... *C.A.R. de Albuquerque, S. Capedri, and J. Dostal* 1493–1496

Formation of peridotites by deserpentinization in the Darrington and Sultan areas, Cascade Mountains, Washington ..... *Joseph A. Vance and Michael A. Dungan* 1497–1508

Emplacement history of the Tatoosh volcanic-plutonic complex, Washington: Ages of zircons ..... *James M. Mattinson* 1509–1514

Mineralogical and chemical evolution of contaminated igneous rocks at a gabbro-limestone contact, Christmas Mountains, Big Bend region, Texas ..... *Raymond Joesten* 1515–1529

Structural-metamorphic chronology in a roof pendant near Oakhurst, California: Implications for the tectonics of the western Sierra Nevada ..... *L. R. Russell and S. E. Cebull* 1530–153[illegible]

Radiocarbon profile of Hanauma Reef, Oahu, Hawaii: Discussion and reply

Discussion ..... *Harold T. Stearns*

Reply ..... *W. H. Easton* 1535–1536

NOVEMBER

The surface of Venus as revealed by Soviet Venera 9 and 10 ..... *C. P. Florensky, L. B. Ronca, A. T. Basilevsky, G. A. Burba, D. V. Nikolaeva, A. A. Pronin, A. M. Trakhtman, V. P. Volkov, and V. V. Zazetsky* 1537–1545

Petrochemistry and tectonic origin of the Ammonoosuc Volcanics, New Hampshire and Vermont ..... *John N. Aleinikoff* 1546–1552

Origin and history of upper Pleistocene marine terraces, San Diego, California ..... *J. Philip Kern* 1553–1566

Meiji sediment tongue: North Pacific evidence for limited movement between the Pacific and North American plates ..... *David W. Scholl, James R. Hein, Michael Marlow, and Edwin C. Buffington* 1567–1576

Deformation of ooids by compaction in the Precambrian Bhander Limestone, India: Implications for lithification ..... *S. K. Chanda, Ajit Bhattacharyya, and Soumen Sarkar* 1577–1585

Comparison of the bottom nepheloid layer and late Holocene deposition on Nitinat Fan: Implications for lutite dispersal and deposition ... *Per R. Stokke, Bobb Carson, and Edward T. Baker* 1586–1592

Late Quaternary sedimentation and paleoecologic history of Chaco Canyon, New Mexico ..... *Stephen A. Hall* 1593–1618

Holocene faulting in the western Grand Canyon, Arizona .. .. *Peter W. Huntoon* 1619–1622

Geology of the Sagamore Canyon–Slaughterhouse Spring area, New York Mountains, California .... *B. C. Burchfiel and Gregory A. Davis* 1623–1640

A thrust plate of ophiolitic rocks in the Preston Peak area, Klamath Mountains, California ..... *Arthur W. Snoke* 1641–1659

Effects of submarine alteration on K-Ar dating of deep-sea igneous rocks ..... *David E. Seidemann* 1660–1666

Deformation associated with the movement of the Muddy Mountain overthrust in the Buffington window, southeastern Nevada ..... *William G. Brock and Terry Engelder* 1667–1677

Macroscopic polyphase folding illustrated by the Toxaway dome, eastern Blue Ridge, South Carolina–North Carolina ..... *Robert D. Hatcher, Jr.* 1678–1688

Distribution of large basaltic intrusions in the Icelandic crust and the nature of the layer 2–layer 3 boundary .... *Ingvar Birgir Fridleifsson* 1689–1693

A former continuation of the Alps: Discussion and reply
Discussion ..... *Gil Chabrier and Georges H. Mascle*
Reply ..... *Walter Alvarez* 1694–1696

DECEMBER

Late Wisconsinan ice recession in east-central New York ..... *Donald B. Krall* 1697–1710

Geochemistry of tholeiites of the Basic Igneous Complex of northwestern South America ..... *P. J. Goossens, W. I. Rose, Jr., and Decio Flores* 1711–1720

Granitic and metamorphic rocks of the Taif area, western Saudi Arabia ..... *A. O. Nasseef and I. G. Gass* 1721–1730

Organic carbon in surface sands seaward of Altamaha and Doboy Sounds, Georgia ..... *Paul R. Pinet and Robert W. Frey* 1731–1739

Structural relationships in the Antalya ophiolite complex, Turkey: Possible model for an oceanic ridge ....*T. Juteau, A. Nicolas, J. Dubessy, J. C. Fruchard, and J. L. Bouchez* 1740–1748

Kinematics and regional tectonic implications of the east-trending fold belt of Peru ..... *V. F. Hollister* 1749–1755

Late Wisconsinan eolian activity near Albany, New York ..... *John J. Donahue* 1756–1762

Tertiary uplift history of the Troodos massif, Cyprus .... *A.H.F. Robertson* 1763–1772

Quaternary glaciation, west-central Maine .... *Harold W. Borns, Jr. and Parker E. Calkin* 1773–1784

Paleomagnetism of upper Precambrian to lower Paleozoic intrusive rocks from Colorado ..... *R. B. French, D. H. Alexander, and R. Van der Voo* 1785–1792

Stratigraphy and structure of La Encantada Mine area, Coahuila, Mexico .... *Gian Paolo Lozej and Frank Beales* 1793–1807

Rb-Sr age of the New Hampshire Plutonic Series .... *John B. Lyons and Donald E. Livingston* 1808–1812

Late Quaternary deposition of ice-rafted sand in the subpolar North Atlantic (lat 40° to 65°N) .... *William F. Ruddiman* 1813–1827

Displacement of relict zircons during growth of feldspathic porphyroblasts ..... *Rae L. Harris, Jr.* 1828–1830

Petrology of Tertiary and Quaternary volcanic rocks, Washington County, southwestern Utah .... *W. D. Hausel and W. P. Nash* 1831–1842

Rb-Sr geochronology and evolution of the Grenville province in northwestern Quebec, Canada. ..... *Ronald Doig* 1843–1856

ERRATA

Replacement pages for pages 1404 and 1406 of v. 88, Tectonic evolution of the Cocos-Nazca spreading center by *Richard Hey* ..... ii–iii

Other errata ..... iv–vi